Reprinted from the Archives of Neurology and Psychiatry
December, 1929, Vol. 22, pp. 1163-1171

THE RÔLE OF INFECTION IN THE ETIOLOGY OF TICS*

LAURENCE SELLING, M.D.
PORTLAND, ORE.

Until recently, the problem of tic has been considered settled. Following the lines laid down by Charcot and Brissaud, Meige and Feindel, in 1905, published the results of their comprehensive studies under the title "Tics and their Treatment." According to them, the tic is of psychogenic origin. The fundamental basis on which it develops is a psychopathic personality. The essential element in that personality is volitional weakness. What begins as an expression movement, or a defense movement, or an irritation movement, by frequent repetition becomes automatized. Then, because of the volitional weakness, the automatized movement gets out of control and becomes exaggerated and deformed, a caricature of its former self.

The views expressed by Meige and Feindel were generally accepted for a number of years. They were in line with the prevailing views regarding the etiology of the group of disorders which are now known as the motility disorders. With the exception of chorea, practically this entire group was classed with the neuroses. In the last few years, facts have been accumulating which have taught that the motility disorders belong not to the neuroses, but to organic neurology. This has been accepted for most of the group, but one has been rather slow in accepting it for the tics. It is of interest that the most recent comprehensive study of tics, that of Wilder and Silbermann, still attempts to explain the condition on a psychogenic basis and uses a modified psychoanalysis as the basic method of treatment. They recognize clearly the organic nature of the tic movement as it occurs, for instance, in epidemic encephalitis; but they fail to carry the analogy over to the group of disorders which are commonly understood as tics. Failure to recognize the tic as an organic disease is largely due to the lack of a definite, clear etiology. The purpose of this paper is the presentation of new evidence bearing on this point.

Of the evidence already at hand, there is the relationship of tic and chorea. While the movements in the two diseases differ, one can always pick out isolated movements in chorea identical with those of

* From the Department of Medicine, University of Oregon Medical School.
* Read at the Fifty-Fifth Annual Meeting of the American Neurological Association, Atlantic City, N. J., May 27, 1929.

tic, and conversely in cases of tic some movements identical with chorea. It is true that chorea minor, like rheumatic fever, is a self-limited disease, running a definite course, and as such differs from tic. There are cases of chorea, however, in which recurrences come so close together that the chorea minor goes over into a chorea intermittens, and even into a chorea permanens, in which the analogy to tic is very close. But most important is the fact, pointed out by Meige and Feindel and reemphasized recently in an excellent and comprehensive study by Irwin Strauss, that typical tic movements may develop as residual manifestations of a typical chorea minor.

Another factor suggesting the organic etiology of tics is the relation to torticollis. Many cases of tic show movements of the head identical with those of torticollis. As a matter of fact, torticollis is often classed with the tic group. Since Cassirer has pointed out that torticollis may be merely one part of a dystonia musculorum deformans, at least some cases of torticollis have been accepted as organic. Cassirer himself did not accept them all but believed that the identical picture might occur on a purely psychogenic basis. I believe that further observations will bring an ever-increasing number of these cases into the organic field. Rosenow's experimental work with torticollis has been suggestive.

The strongest evidence in favor of the organic origin of the tic was offered by the epidemic of lethargic encephalitis. Here for the first time one saw the different types of hyperkinesias, myoclonus, torsion, tremor and tic, occur singly and together in cases of known and accepted organic etiology. In observing tics today, one is constantly reminded of analogies to epidemic encephalitis. This is true not only of the simpler tic movements, but also of the more complex. In cases of tic one sees definite compulsive eye movements of short duration, which strongly suggest abortive types of oculogyric crises; and one sees respiratory irregularities which are related to the respiratory anomalies of the postlethargic states.

Led by these considerations, and especially by the analogies existing between chorea minor and tic, I have attempted the study of a series of cases of tic from the standpoint of the search for foci of infection and the removal of infection when found. I am reporting here the three cases which have been longest under observation.

REPORT OF CASES

CASE 1.—*Clinical History.*—P. S., a boy, aged 14, was the first child in the family and was born by a normal delivery. Development was normal. Physically, he was strong and healthy; mentally, he was intelligent and alert. He was sensitive and shy, and emotionally somewhat unstable, with a tendency to brief depressive periods. There was always some motor hyperactivity. He was definitely a nervous type.

He was well until the age of 6, when he developed a severe sinus infection which lasted three months. During this time he became run down physically, and grew pale and anemic. Toward the end of this period, during an attack of chickenpox, a blinking tic developed. From this time on he was definitely a tiqueur. At first there were free intervals, sometimes weeks long; but the tic showed a progressive tendency, and the attacks became more frequent, more severe and more extensive. Between the ages of 8 and 9, in addition to a variety of other tics, such as blinking, twitching of the face, lateral and vertical eye movements, clearing the throat and sniffing, he developed torticollis movements and even an occasional torsion movement. Everything he did was rapid and jerky. There was a constant "Rededrang." He was constantly under tension, and there was marked motor restlessness.

After the tenth year, the physical condition began to improve. He became stronger and more robust. The tics improved somewhat. From the ages of 12 to 14, there was further improvement. Blinking was reduced, torticollis movements definitely improved, and the other movements were proportionately improved. But the state of tension and the general motor restlessness were always present, and there would be spells when all the tics would return in exaggerated form.

It has been stated that the beginning of the tic followed a prolonged sinus infection. For the next few years, colds and sinus infections, particularly antrum infections, were frequent and protracted. It was noted that there was a definite relationship between these infections and exacerbations of the tic movements. After the tenth year, the infections became less frequent, and at this time the general physical condition began to improve and the tics subsided somewhat. It was felt that there was a definite causal connection. However, another factor had to be considered. Beginning at the eighth year, training movements were started. These included relaxing exercises and controlled movements of the type usually used in these cases. They were carried out for twenty-five minutes, twice a day, over a period of years. There is no doubt that they helped, and that they must be considered in the evaluation of the case.

In July, 1928, the boy developed the first severe cold he had had for a long time. It lasted for several weeks. With this came a marked and definite flare-up of the tics. For a few days they were almost violent. Examination at this time by Dr. Kistner showed a subacute flare-up of the old antrum infection.

When I reviewed the case with Dr. Kistner at this time, the following facts stood out: 1. The first appearance of the tics followed a prolonged sinus infection. 2. Recurrent sinus infections were accompanied by exacerbations of the tic. 3. 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. 4. A final flare-up of the infection was again accompanied by a recrudescence of the tics.

Operation.—The connection between sinus infection and the tic was too definite to disregard. When one considered the number of reinfections over a number of years and the long periods during which conservative treatment had been tried, it was evident that there was no chance of cleaning up the sinuses permanently except by operation. All the sinuses (the frontal sinuses excepted) had been involved, but Dr. Kistner decided to do only a radical operation on both antrums. This was chosen for two reasons: 1. The antrum had always shown more infection than the other sinuses. 2. It is not uncommon, when a relatively mild sphenoid and ethmoid infection accompanies an antrum infection, to find that the sphenoid and ethmoid sinuses will clear up spontaneously after the antrums have been radically operated on. The operation was done on Sept. 12, 1928.

Course.—This paper was written more than eight months after the operation. No one who knew the patient before and since could doubt the result. Previous to operation there was always the tension with the readiness to jump or turn or answer to any stimulus; there was the continuous restlessness, and there were tics of varying intensity. Since operation, the tics are reduced to minimum, an occasional blink or a twitch; only a little motor restlessness is present; the tension, one of the most disturbing of all symptoms, is practically gone. To the casual observer now, the patient is a normal, but rather nervous, boy.

A summary of Dr. Kistner's record of the patient from 1920 to 1929 is appended:

Nov. 11, 1920: Frequent colds. Diagnosis: acute sinusitis.

March 24 ,1921: Left chronic otitis media. Acute sinusitis.

Jan. 8, 1922: Roentgen examination of sinuses shows: left antrum less well illuminated than right; ethmoids hazy and poorly defined; frontal cells absent.

May 16, 1922: Acute rhinitis. Catarrhal otitis media. Under treatment for from three to four weeks—aspiration and douching.

Nov. 16, 1923: Acute rhinitis—duration several weeks. Roentgen examination of sinuses showed: left antrum opaque, margins hazy; right antrum apparently clear; ethmoids distinctly hazy and show little structure. Definite increase in density. Sphenoid hazy. Frontal cells absent.

Sept. 2, 1924: Acute sinusitis. Roentgen examination showed: right antrum ++; left antrum ++++. Treatment consisting of washing the antrums was given for about three months.

Dec. 11, 1924: Left antrum; while well outlined, shows distinct haziness of outline. Right antrum apparently clear. Ethmoids show haziness and moderate density on both sides. Sphenoids show haziness of G line. Illumination not bad. Frontals absent.

Feb. 21, 1925: Acute rhinitis, two weeks' duration. Antrums fairly well illuminated; margins somewhat blurred. Ethmoids hazy and show increased density on both sides. Sphenoid poorly illuminated. G line hazy. Frontals absent.

Aug. 8, 1928: Complaint: Cold of two or three weeks' duration. Roentgen examination showed right antrum smoky; borders fuzzy. Left antrum shows slight increased density; borders fuzzy. Ethmoids blurred. Sphenoids show increased density. Borders thickened. Frontal cells absent. Proof puncture showed definite evidence of subacute infection in both antrums. The sinusitis cleared slowly.

Sept. 12, 1928: Double radical antrum operation. General polypoid thickening throughout both antrums, more pronounced on the left side. Cultures from material obtained at operation showed: from the right swab, a growth of alpha hemolytic greenish short chained streptococci; from the tissues, *Staphylococcus albus;* from the left swab, a growth of *Staphylococcus albus, Micrococcus catarrhalis* and alpha hemolytic greenish streptococcus; from the left tissue, *Micrococcus catarrhalis* and alpha hemolytic greenish streptococcus.

Case 2.—*Clinical History.*—H. S., a boy, aged 11, was seen on Oct. 13, 1928. The history obtained from the father was that the patient was an only child, born at full term by instrumental delivery. There was no birth trauma. The birth weight was 7½ pounds (3,401.9 Gm.). There were feeding difficulties at 5 months, and an acute illness at 14 months. At this time the father and mother were estranged, and from then until the age of 5 the child was the object of continuous wrangling between the parents. According to the father, this was a severe ordeal for the child. The tonsils and adenoids were removed when he was 5. He started school at 6; the teacher considered him nervous and arranged his work accordingly.

For two years he did well. Then at the age of 8 he began to be lax in his studies and showed an inability to apply himself and to concentrate. He just "got by" each term. He became increasingly nervous, and a tic developed.

After a vacation he was better, but when he returned to school many new tics developed: blinking, jerking shoulders, looking suddenly back and peeking furtively into corners. He managed to finish the school year and made his grade. En route to the mountains for a vacation, he had a spell of intense nervousness; for a time muscular control seemed completely gone. A second episode of this type occurred soon after, and he was brought to Doernbecher Hospital in August, 1928. In ten days he became much more quiet and was discharged.

When he started to school in the fall, his condition became so bad that he was returned to the Doernbecher Hospital. On the train he became uncontrollable; there was jerking, twisting and writhing of the whole body; the breath came in gasps; he was unable to talk, and he could produce only staccato shrieks.

In giving the history, the father could not set any definite time at which the twitchings began. It came on in the eighth year, apparently unrelated to any acute illness. After the onset the course was definitely progressive, though with remissions.

Examination.—The patient was under observation in the hospital for some time, and showed a good deal of variation in behavior. There were times when he was fairly quiet, but these were the exception. For the most part he was exceedingly restless and was continuously in movement. When he sat reading, he twitched constantly; there were jerking movements of the arms and legs, and turning movements of the head and eyes. In moving about the ward he walked quickly and jerkily; he turned toward any slight stimulus of sight or sound, with impulsive suddenness. He was noisy, talkative and overloud in speech. He was forever interrupting others and must have his say. The voice was suddenly raised and lowered, and some words were uttered explosively. Everything he did was unsteady, jerky and irregular.

The boy had a pleasing personality, and was cheerful, friendly and cooperative. He was well liked in the ward. Occasionally, however, when the motor restlessness became more intense he made a nuisance of himself, tearing up books and pictures, throwing things around, and showing a definite tendency to destructiveness.

Neurologic examination gave essentially negative results. There was a slight muscular hypotonia. A general physical examination gave negative results except for a diffuse redness of the pharynx. The tonsils had been removed.

The sinuses were examined by Drs. Kistner and Bailey. When the nose was douched, nothing was obtained. Following proof puncture of the right antrum, a large globule of mucopus was blown from the nose. Shreds of the same type of pus were found exuding from beneath the right middle turbinate. Roentgen examination showed the right antrum to be dense, 4+; the margins were thickened. The left antrum was dense, 2+; its margins also were thickened. The frontal cells were well illuminated. The right ethmoid was somewhat blurred. The left ethmoid was well illuminated. The sphenoids were well illuminated.

The examination was rechecked, and the conclusion was reached that while the examination of the sinuses did not give definitely positive results, there was sufficient evidence of chronic bilateral disease of the antrums to justify exploration with a view to a double radical antrum operation if the observations should indicate it.

Operation.—The exploration was done on Nov. 14, 1928 by Dr. F. B. Kistner. Definite pathologic change was found on both sides. There was hyperplasia of the

lining membranes with cystic abscesses. Radical operation was done on both antrums. The observations were as follows: The right side showed moderate thickening and edema throughout. One large cystic abscess and two smaller ones were found in the lining. There was no free pus. The left side showed thickening and edema of the alveolar recess. The remainder of the lining showed little change.

Pathologic Report (Drs. Benson and Menne).—Cultures of the left antrum contained *Staphylococcus albus* and *Micrococcus catarrhalis*. Cultures of the right antrum contained alpha hemolytic greenish streptococci. From 4 to 5 cc. of broth culture from the right antrum was injected into a rabbit. No nervous symptoms developed. Autopsy after four days showed pus in the knee joint of the left hind leg, but cultures were sterile. The brain appeared normal; cultures were negative. Cultures of the heart blood were negative. No other pathologic change was found.

Course.—Nov. 26, 1928: The operative recovery was good. After the operation, there was a definite change in the condition. The boy was quieter, more relaxed and less tense. The suddenness and jerkiness of movement and the explosiveness of speech were strikingly modified. The "Rededrang" was gone. The tics were reduced to a minimum. He had changed from a high strung, hyperactive and overreacting boy to a quiet, contained, and almost normal one.

March 26, 1929: During the last four months there have been two or three periods of motor restlessness with a return of the old tics, in much subdued form. These spells usually come when he attempts to return to school. One of them was quite severe, and lasted two or three weeks. This subsided. At the time this paper was written he was quiet, and had been attending school for several weeks without any difficulty. He still has occasional tics and twitches, and is still a little overactive at times, but the approach to normality is close.

CASE 3.—*Clinical History.*—E. R., a boy, aged 14, complained of jerking of the head and arms, and of inability to progress in school. The family history was not significant. The patient was the fifth child and was born at term without the use of instruments. He walked at 1½ years of age and talked at about 2 years. He had measles at 2 years and had had a few head colds. He started school at 7, and passed the first grade, but failed in the second and again in the fourth grade. The year before the present illness, he passed into the sixth grade, but he did not get along well. Up to the time of the present illness, he had been normal as far as physical activities were concerned; he was fond of athletic sports, and did well in them.

The present illness began six months before this paper was written. There was no history of any acute illness preceding it. The onset was acute; it "came all at once." He developed abnormal movements which consisted of such things as: "stretching the face"; turning up the eyes; throwing out the right arm; kicking up the right leg in running; blinking; twitching the head, and making guttural noises. At first one of these movements would come, remain for a time, and then disappear. Its place would then be taken by another. Things got gradually worse until three months before presentation, when the condition was stationary.

Examination.—Nov. 16, 1928: The patient was undersized and undernourished. The striking manifestations were the hyperkinesias. They consisted of blinking movements; facial tics of one or both sides; turning the head and eyes; jerking the head down and back; sniffing, grunting and mildly explosive noises. All these movements were quick, sudden and jerky. There were also other types of movements, such as sucking the lips and throwing the leg in walking.

The boy was friendly and cooperative. He seemed rather indifferent to his ailment—certainly he was not troubled by it. In cases 1 and 2, the basic state was one of tension, and the restlessness and jumpiness and even the abnormal movements seemed to be an expression of that tension. Here there was no tension; the basic state was one of quiet; the tics seemed superimposed, as something foreign, and the patient seemed to consider them as such and to disregard them.

Aside from the presence of the tics, neurologic examination showed nothing abnormal.

A general physical examination showed enlarged tonsils and adenoids, a congested pharynx, cervical adenopathy and a slight secondary anemia.

Mental Rating: The chronologic age was 14 years and 5 months and the mental age, 11 years and 2 months. The intelligence quotient was 77. The case belongs in the upper borderline group.

Examination of the nose and throat by Drs. Kistner and Bailey revealed the fact that the patient had two or three colds a year, each lasting two or three days. He had not had sore throats. Pus was present on the floor and in the right middle meatus as well as in the left middle meatus. The tonsils were large and slightly congested. Examination of the nasopharynx showed pus streaked over the adenoids. Roentgen examination of the sinuses revealed: right antrum dense, 2+; margins thickened; left antrum, no increased density; borders blurred. The frontal cells were dense, 1+; their structure was blurred. The right sphenoid was dense, 1+, and the margins hazy. The left sphenoid was dense, 1+, and the margins thick.

On proof puncture, the material washed from the antrums showed gross pus on both sides.

The observations at this examination were: infected tonsils and adenoids, and bilateral purulent antrums. It was decided to remove the tonsils and adenoids first and to watch the results. The operation was done on Nov. 30, 1928.

Course.—There was no improvement following this operation. Therefore, six weeks later, a bilateral radical antrum operation was done. The operative report was: "Chronic antral disease; definite thickening with polypoid edema and fibrosis on both sides. It looks as though pus were present in the other sinuses, particularly the left (probably the left ethmoid)." Nothing was done to the sphenoids and ethmoids at this time.

Following the operation, the patient showed definite improvement. There was considerable reduction in the frequency and intensity of the tics, but the improvement did not satisfy expectations. As it was known that pus was still present in the other sinuses, it was requested that they, too, be operated on. On Jan. 27, 1929, six weeks following the antrum operation, Dr. Kistner did a bilateral intranasal ethmosphenoidectomy. There was definite thickening of the lining of the cells on both sides, more pronounced on the left.

Since this operation, the patient has been showing slow but steady progress. All that is left of the mass of tics which existed before is an occasional twisting of the head and turning of the eyes. The contrast with the preoperative state is striking and gratifying.

COMMENT

The three cases are all typical of tic. Two had lasted for several years, one for several months. In all three there was definite evidence of focal infection. Two patients had chronically infected antrums; one had infected tonsils, adenoids, antrums, ethmoids and sphenoids.

Radical removal of the foci of infection in all three cases resulted in definite and striking improvement. In one case the tonsils and adenoids were removed first, without effect on the tics. Subsequent operation on the antrums, ethmoids and sphenoids resulted in marked improvement. Up to the present, every patient with tic whom I have examined, with one exception, has shown definite evidence of sinus infection. The one exception, the case of P. M., is not reported here. His tic is relatively mild. The only foci of infection found were tonsils and adenoids. Studies of the sinuses were inconclusive. The tonsils and adenoids were removed, and there was some improvement. When the patient was last seen the tic had not entirely disappeared; if the course is unfavorable exploration of the antrums will be considered.

The constancy with which sinus infection, and especially antrum infection, has been found in three cases and the satisfactory results obtained from radical treatment of these foci have led to the conclusion that: 1. Tic is an infectious disease in the same sense that chorea is an infectious disease. 2. The commonest site of the infection is the sinuses, particularly the antrums.

In none of the cases reported has there been a complete return to normality. All three patients show occasional grimaces, occasional turning of the head and eyes and some unnecessary activity. But this is expected. If, as I believe, these are cases of toxic encephalitis, it is not surprising that absorption over months and years has caused enough permanent damage to nerve cells to leave permanent residual symptoms. What has impressed me is not these residua, but the fact that in spite of long duration of the disease, and in spite of the intensity of the symptoms, the clearing up of the focal infection has still been able to produce such a striking amelioration, amounting as far as the usefulness of the patient is concerned, to a complete cure.

In looking over the three case histories, one finds the common etiologic factors to which the tics are attributed, but a different factor in each case: in case 1, a nervous constitution; in case 2, conflicts in the home which upset the child emotionally; in case 3, a subnormal mentality. These factors were individual. But the factor common to all three was infection.

As one considers the usual course in a case of tic, one finds it compatible with an infectious etiology. The mild cases clear up spontaneously. The moderately severe ones show long periods of exacerbation and periods of partial or complete remission. The most severe cases have a chronic progressive course, as in the maladie de la Gilles de la Tourette. The course in any given case will be determined by the severity of the infection. Spontaneous healing of the infectious focus—and this must happen often—leads to spontaneous cure. If the healing is temporary and reinfections occur, there will be remissions

and exacerbations. If the infection is severe and persistent, then the progressive tics will be found. I have not yet had an opportunity to study a case of maladie des tics, but the difference is one of degree and not of kind, and one would expect the same etiologic factors to be operative.

It is obvious that every sinus infection does not produce a tic any more than every tonsil infection produces nephritis, an arthritis or an endocarditis. There must be a definite specificity of the infection for certain tissues in tics, just as there is in other focal infections with which one is familiar.

The observations in the group of cases reported, and in other cases under observation justify the conclusions that have been drawn. I do not assume that every tic movement represents a focal infection, nor even that every case must be organic. It is entirely possible that a somewhat similar picture may develop on the basis of imitation. It is highly probable that cases can develop on the basis of developmental anomalies of the brain. It is certain that tic movements can occur on the basis of epidemic encephalitis, as residual symptoms of chorea minor and as a result of cerebral accidents, such as hemorrhage. But I am convinced that the overwhelming bulk of what are ordinarily classed as "tics" are the result of a toxic encephalitis due to absorption from an extracerebral focus of infection, and that the adequate treatment in these cases depends on early recognition and proper handling of the infection.