BRITISH MEDICAL JOURNAL

LONDON SATURDAY FEBRUARY 24 1940

PNEUMOCOCCAL PAROTITIS

BY

REGINALD T. PAYNE, M.S., M.D., F.R.C.S.

Surgeon, Emergency Medical Service, Sector VI, St. Mary's Hospital

The common types of pyogenic parotitis are caused by the *Staphylococcus aureus*, the *Streptococcus viridans*, and the pneumococcus. Each of these bacteria gives rise to a pathological and clinical type of the disease with certain clearly defined features. The *Staph. aureus* characteristically gives rise to acute parotitis, the *Strep. viridans* to recurrent parotitis, and the pneumococcus to a recurrent type of the disease in which the exacerbations are severe and may pass on to suppuration and abscess formation. Many other bacteria may occasionally lead to parotitis, but they are seldom met with. Of the three common bacteriological types of parotitis the pneumococcal is the least frequent and the least well recognized, the staphylococcal type being the most common.

The present paper is based on a series of seventeen cases of pneumococcal parotitis which have been under my care and which form the basis of the discussion of the aetiological, pathological, clinical, and prognostic features of the disease. In previous communications (Payne, 1933, 1938) I have described the characteristic features of the disease caused by the *Staph. aureus* and by the *Strep. viridans* respectively. The pneumococcal group presents certain well-defined features in its natural history that have important bearings upon the question of treatment. The recognition of the bacteriological type in any given case of parotitis is not merely of academic importance, but is fundamental in relation to the questions of therapy and prognosis.

Clinical Material

The majority of the seventeen cases now recorded occurred in my own practice; the remainder were under my care at St. Bartholomew's Hospital. Four of the cases were acute, twelve were recurrent, and one case was chronic in type. This classification into acute, recurrent, and chronic cases should not be accepted too rigidly, and some overlapping of the groups certainly occurs. In general, pneumococcal parotitis tends to be of the recurrent type, but the acute case may pass into the recurrent group or the chronic cases show a tendency towards some of the phenomena of the recurrent type. In Table I the main features of the seventeen cases are set out in detail.

Aetiology

There is no single aetiological factor which is constantly present in pneumococcal parotitis; but I do not believe that this type is any exception to the general rule that pyogenic parotitis always has in the background some impairment of the mechanism of mastication. This impairment may be due to dental disease, dental loss, imperfect occlusion, or ill-fitting dentures; it may be due to a deliberate or voluntary restriction of diet in association with acute or chronic illness; or in some cases it may simply be that certain individuals are "poor chewers," often from psychological causes. The importance of mastication is paramount, since this is the most potent stimulus to salivation, and particularly to parotid secretion. If the chewing mechanism is impaired from any cause whatever, then the saliva is seriously diminished in amount and the flora of the buccal cavity is greatly enhanced and even altered. If every case of pyogenic parotitis, whether acute, recurrent, or chronic, is considered along these lines it will be found that a disturbance of the chewing mechanism has preceded the onset of the parotitis, either as a long-standing phenomenon or as a recently developed one. Once infection of the duct system of the parotid has occurred the anatomical configuration of the gland favours its persistence. To these general observations pneumococcal parotitis is no exception. But whereas the type due to the *Staph. aureus* tends either to recover spontaneously or following operation, or to end fatally, that due to the *Strep. viridans* tends to persist in the recurrent form, while the pneumococcal type is characteristically a recurrent type with severe exacerbations which may pass on to suppuration.

The following are some of the more important and detailed aetiological factors in the seventeen cases now recorded.

Sex.—The present series comprised seven males and ten females. There were four acute cases (two males, two females) and one chronic case (male). Of the twelve recurrent cases four were in males and eight were in females. This greater incidence of recurrent cases in females is strictly comparable to the much greater incidence in this sex of the cases due to the *Strep. viridans* (Payne, 1933).

Age Incidence.—The figures given in Table I show that no age is entirely exempt from pneumococcal parotitis. Of the

TABLE I.—Principal Features of the Series of Seventeen Cases of Pneumococcal Parotitis

ACUTE											
Case No.	Sex	Age	Side	Cause	Bacteriology	Treatment	Result	Comments			
1	F	65	R & L	—	Pneumococci	Conservative	Cure	Condition developed in hospital while awaiting eye operation			
2	M	16	L	Fatigue after cycling 150 miles on previous day	"	"	"	—			
3	F	60	R	? Antecedent obscure pulmonary infection	Pneumococci Type II	"	"	As a young woman nearly died from an acute left-sided parotitis. A left auriculo-temporal syndrome with sweating and hyperaemia on eating had persisted since this illness			
4	M	12	L	—	Pneumococci	"	"	—			
RECURRENT											
Case No.	Sex	Age	Side	Cause	Duration	Attacks	Saliva	Bacteriology	Sialography	Treatment	Result and Comments
5	F	5	R	? Enlarged tonsils. Tonsillectomy 6 months previously. Parotitis started just before operation	7 months	Many, lasting up to a week	Scanty; contained mucus	Pneumococci	—	Conservative	Improved
6	M	44	R	? Chill following driving	11 months	Many, lasting up to 3-4 days	Copious; contained large masses of gelatinous mucus	Pneumococci, also <i>Staph. albus</i> and <i>Micro. flavus</i>	Marked dilatation of main duct, with constriction proximal to orifice	Dilatation. Duct operation refused	Improved, and saliva became much clearer. Narrowed duct orifice easily felt with dilators
7	M	5	L	—	2 years	At first every 3 months, now every month. Last about 6 days and are very painful	Muco-pus	Pneumococci	—	Conservative	No further attacks
8	F	51	R & L	Teeth all removed 15 years ago; has never worn dentures	13 years R; 4 years L	Constant severe attacks R and L. Abscess drained L 6 years ago. Much ill-health	Thick greenish-yellow mucus	Pneumococci, Type IV, later proved Type VII	Gross dilatation of ducts, with globular dilatation in glands	Duct operations R and L, and external drainage R parotid. X rays	L cured; R improved
9	F	13	L	During teething. Constant trouble with teeth	12 years	5 severe attacks, many minor ones. Serious impairment of physical and mental health	Profuse, thick, tenacious, greenish mucus	Pneumococci, Type IV	Dilatation of main duct, with globular dilatations in gland	Duct operation. X rays	Cure. Complete functional obliteration of gland. Rapid improvement in health
10	M	4½	R & L	During teething	3½ years	4 attacks	Muco-pus	Pneumococci	Slight dilatation of finer ducts	—	Discharged at parent's request
11	M	34	R	Eczema as a child. Mother has asthma very badly	5 years	Very severe attack of bilateral parotitis 5 years ago. Since then attacks every few days	Profuse mucus from both sides	"	—	—	Did not attend subsequently. Right duct orifice was patulous
12	F	33	R & L	—	1 year	Left parotid up and down every few days	Muco-pus	"	Both sides normal	X rays	Improved
13	F	9	R	—	13 months	4 in all. Take a few hours to develop; lasting two days	"	"	—	—	Did not attend further
14	F	40	L	—	5 years	Every 2-3 months; lasting 3-4 days	"	"	Marked segmental dilatation affecting chiefly main duct	Duct operation	Much improvement, but attacks started 5 months later
15	F	44	R & L	4 years ago all teeth out for pyorrhoea	18 months	1 attack R, 3 attacks L. Seen during severe acute attack on L, with marked constitutional disturbance	Thick yellowish mucus	"	—	Conservative at onset, then drainage of two large abscess cavities in left parotid	Cured
16	F	2½	R & L	During teething	22 months	Many	Blobs of mucus	Pneumococci, Type II	—	Conservative	Under treatment
CHRONIC											
17	M	45	R	—	19 years	Constant local pain and swelling. A few mild recurrent attacks. External salivary fistula for past 2 years	Muco-pus	Pneumococci	—	Exploration and drainage of gland, no calculi present. X rays	Cured

four acute cases two occurred in later middle life (ages 65 and 60) and two in adolescence (ages 16 and 12). Of the twelve recurrent cases three started between the ages of 1 and 2, three between the ages of 3 and 8, and the remaining six at ages varying from 29 to 43. It is apparent, therefore, that in the recurrent group one-half of the cases developed during the period of either the first or the second dentition, and the remainder during the first half of adult life. Case 17, the only one to which the term chronic can be applied, started at the age of 26.

Duration.—In the recurrent group of cases the duration of symptoms before coming under my observation varied from seven months to thirteen years. The one chronic case had given rise to symptoms extending over nineteen years. These figures indicate the great tendency to persistence which characterizes the pneumococcal type of parotitis.

Side Involved.—The twelve recurrent cases involved the right side in four, the left side in three, and both sides in five. In these five bilateral cases the disease had involved both sides at onset in four, and in the remaining case the parotitis developed on the second side nine years after the first.

Dental Factors.—It has already been pointed out that in the recurrent group one-half of the cases started during the period of either the first or the second dentition, and in some of the cases beginning in infancy the mothers volunteered the information that the condition started with the onset of teething. In Case 9, that of a girl of 13, the parotitis had been present since the age of 1 year and 10 months, and the patient had always had great trouble with her teeth, was constantly under her dental surgeon, and was still wearing apparatus when she came under observation. Full dental details are not available for all the earlier cases occurring in adults. In Case 8, however, that of a woman of 51 who had had all her teeth removed fifteen years previously and who had never worn her dentures, the parotitis had been present for thirteen years on the right side and for four years on the left.

Allergic Factors.—It has been suggested that an allergic factor is responsible for some of the cases of parotid enlargement seen in infancy and childhood. Several of the published cases certainly suggest that this may be the fact, but personally I have yet to see a case of recurrent parotid enlargement in infancy in the absence of both pus and bacteria as determined by the results of catheterization of the duct. Patient No. 11, a man aged 34, suffered from eczema as a child but had never had hay-fever or asthma, although his mother suffered from these two diseases. The parotid secretion from this patient was profuse muco-pus, which yielded a pure growth of pneumococci from the two sides.

Enlarged Tonsils.—There is nothing in the series as a whole to suggest that tonsillar infection as such played an important part. In Case 5, that of a girl of 5, tonsillar enlargement was thought to be the predisposing factor, and tonsillectomy was carried out one month after the onset of the parotitis and six months before the patient came under my care.

Fatigue and Chill.—It is possible that fatigue and chill may occasionally be factors leading to the onset of parotitis by causing diminution in saliva, alteration in buccal flora, and diminished tissue resistance. In Case 2, a youth aged 16 developed acute pneumococcal parotitis the day after getting very fatigued from cycling 150 miles in a day. Patient No. 6, a man aged 44, attributed the onset of his recurrent right-sided parotitis to an occasion when he got extremely cold while driving his car.

Other Pneumococcal Infections.—There is nothing in the available evidence to suggest that pneumococcal parotitis is specially prone to arise in patients with proved pneumococcal infections. When acute parotitis develops during the course of pneumococcal infection of the lungs it is almost invariably caused by the *Staph. aureus* and not by the pneumococcus. In none of the seventeen cases now recorded was there any evidence pointing to an associated pneumococcal infection; but in Case 3 an unexplained and prolonged pulmonary infection that might possibly have been pneumococcal in nature immediately preceded the development of the parotitis.

Summarizing the available evidence in connexion with pneumococcal parotitis, it is certain that dental factors are important in leading to disturbances of mastication and parotid function, that the recurrent disease tends to develop during the periods of the first and second dentition or during the first half of adult life, that an allergic factor is not proven, and that there is little evidence to relate the development of the disease to other existing pneumococcal infections.

Pathology

No gross or histological material was available for study, as none of the recorded cases came to necropsy, and in none of the cases in which operation was performed would it have been justifiable to remove adequate parotid tissue for histological examination. Certain observations on the pathology of pneumococcal parotitis may be based on a knowledge of other bacteriological types of parotitis and upon the clinical and operative findings in the pneumococcal group.

Pneumococcal parotitis is an ascending infection from the buccal cavity strictly comparable to the other types of pyogenic parotitis, and its main pathological features do not seriously differ from them. The nature of these pathological changes must depend on the acuteness of the process, the degree of duct obstruction, and the extent of the invasion of the gland parenchyma. The evidence does not suggest that the acute type of the disease ever gives rise to miliary abscesses scattered throughout the gland such as I have described in cases due to the *Staph. aureus*. These pneumococcal cases usually resolve fairly rapidly and leave no trace behind. If rapid resolution does not occur, then the process is likely to pass into a recurrent or a chronic phase. In the recurrent cases there are certain features of pathological interest. First, the secretion in the duct system is thick and tenacious and contains a large amount of mucus; secondly, as a corollary of this the ducts as shown by sialography (described in detail later) are of a gross and irregular type; thirdly, there is a tendency to the formation of deep abscesses in the gland tissue during the acute exacerbations; and, finally, the clinical evidence suggests that there is a greater degree of gland destruction and fibrosis than is found in the cases caused by the *Strep. viridans*.

Bacteriology

Material for bacteriological examination was obtained from all cases by catheterization of the parotid duct, and was also recovered from the parotid abscesses in the cases submitted to external drainage. In every case pneumococci were present, and they were often intracellular, either in leucocytes or in the large polyhedral or tall columnar cells found in the secretion in the recurrent cases. Cultures were carried out in fifteen of the cases, and these confirmed the presence of pneumococci. In fourteen of them the culture was a pure one, but in Case 6 it was associated with *Staph. albus* and *Micrococcus flavus*. Typing of the strain of pneumococcus was carried out in four cases, with the following results: Case 3, Type II; Case 8, Type IV, proved later to be Type VII; Case 9, Type IV; Case 16, Type II. It is apparent that no single strain of pneumococcus is responsible for all cases of pneumococcal parotitis.

Clinical Types and Features

Pneumococcal parotitis may be of an acute, recurrent, or chronic type. The limitations of this classification have already been indicated, but it is retained for the purposes of analysis and description.

Acute.—This type develops fairly rapidly during the course of one or two days in a patient who has not previously had parotid trouble (Case 3 is possibly an exception to this). The degree of parotid swelling is moderate, marked tenderness of the whole gland is present, there may be complete duct obstruction, and in the worst cases fever and constitutional disturbance are present. The most acute case in the series was No. 3, and in this instance the question of external drainage was in the balance for several days, but eventually the acute phase cleared up with conservative measures. The degree of associated duct obstruction is naturally an important determining factor in all cases. I have never, however, seen a really fulminating case of pneumococcal parotitis comparable to some of the worst cases caused by the *Staph. aureus* and occasionally by the *Strep. haemolyticus*.

Recurrent.—The main features of this type of the disease are similar to those found in the *Strep. viridans* cases. The only important difference is that the individual recurrent phases are in general more severe, and at times are suppurative in nature and require external drainage. These more serious features of pneumococcal parotitis were particularly marked in Cases 8, 9, and 15. In Case 8, that of a woman of 51 with a thirteen-years history, the attacks were severe, bilateral, and frequent, and an external operation had been carried out on the left side. Subsequently the right side had also to be drained. In Case 9, that of a girl of 13 in whom a left-sided parotitis had been present from the age of 1 year and 10 months, there had been five severe attacks and many minor ones. Pus constantly poured into the mouth in large quantity, and the child's physical and mental development was seriously impaired. Operation from within the mouth was followed by complete functional obliteration of the gland and rapid improvement in the patient's health, mentality, and school work. In Case 15, that of a woman of 44 with an eighteen-months history of bilateral parotitis, an external drainage operation had to be carried out for a very severe acute exacerbation, and operation revealed two large abscess cavities in the gland containing greenish-yellow pus.

Recurrent parotitis due to the pneumococcus thus assumes a more serious nature than that due to the *Strep. viridans*. An element of uncertainty exists in every case, and in no case is it possible to say that suppurative complications may not at any stage necessitate external drainage. In the worst cases the parotid swelling may be great, exquisite tenderness is present, the overlying skin is reddened, and there is constitutional disturbance. In no case was there any extension of the pathological process beyond the limits of the parotid fascia.

Chronic.—Only in one case in the series, No. 17, could the condition really be described as chronic. This patient was a man of 45 in whom a right-sided parotitis had been present for nineteen years, and the main feature was the persistence of local symptoms. Even in this patient there had been a history of some exacerbations, and during one of these, two years previously, a parotid fistula had developed, and this was still present when the patient came under observation.

The only important complications occurring during the course of pneumococcal parotitis are abscess formation within the parotid capsule and external fistula formation. These complications have already been considered in the sections dealing with pathology, and clinical types and features.

The Saliva

During the course of the acute cases the parotid saliva, if the duct is patent, is thick, muco-purulent, and yellowish, and does not differ greatly from that found in the *Staph. aureus* cases. In the recurrent cases the gross appearance of the duct saliva is such that, without being actually pathognomonic of the disease, it is highly characteristic, and it is often possible to make a tentative diagnosis from naked-eye examination. This secretion is profuse in amount, greenish yellow in colour, and very thick and

tenacious, and it contains a large quantity of mucus. Pus cells and epithelial cells are present, but often not in such large numbers as might be expected. The saliva is in striking contrast to that found in *Strep. viridans* cases, in which it is watery and contains large numbers of very small blobs of muco-pus, an effect which I have called "snow-storm" saliva. The practical value of these observations is that at times it is possible to determine the probable nature of the bacteriological type in any case of recurrent parotitis on clinical grounds alone.

X Rays and Sialography

Plain skiagrams should be taken in every doubtful case of acute parotitis, and in all cases of a recurrent or chronic nature it is essential to exclude the possibility of a calculus, the rare miliary calcification which I have found in association with Raynaud's disease and scleroderma, and opacities in the vicinity of the parotid. Parotid calculi are, however, rare in comparison with pyogenic parotitis, and although they are almost always accompanied by some degree of infection I have never found a calculus associated with a pneumococcal condition.

Sialography (Payne, 1931) also sheds some light upon the nature and extent of many of the pathological changes in the duct system, and has important bearings upon the question of treatment. These changes are in general of a much grosser type than those found in association with *Strep. viridans* infection, and they may involve the main ducts, the smaller ducts, or the finest ducts and the acini. The typical fine bronchiectasis is found characteristically in the *Strep. viridans* cases, but it is impossible to be dogmatic in this connexion. At the same time sialography, by giving indications of the nature of the duct changes, may indicate the best line of therapeutic approach.

TABLE II.—A Comparison of Recurrent Parotitis due to the *Pneumococcus* with that due to the *Streptococcus viridans*

	Pneumococcus	Streptococcus viridans
Age	Infancy, childhood, or first half of adult life	Infancy, childhood, or first half of adult life
Sex	Commoner in females ..	Commoner in females
Aetiology ..	Dental factors and imperfect mastication	Dental factors and imperfect mastication
Pathology ..	At times gross duct changes. Tendency to pass into acute phase with abscesses in gland tissue	Duct changes not so gross. No tendency to intra-glandular suppuration
Clinical Features	Recurrent attacks may be very severe and pass on to suppuration, abscess, or fistula formation	Recurrent attacks do not pass on to gross suppuration, abscess, or fistula formation
Saliva	Profuse, greenish yellow; contains muco-pus	Profuse, watery; contains small blobs of muco-pus
Calculi	Not associated	Very rarely associated
Sialograms ..	Segmental or other gross dilatation of major ducts, or irregular dilatation of finest ducts and acini	Typically small globular dilatation of finest ducts and acini
Complications	Abscess formation and external fistula	No tendency to abscess or fistula formation
Prognosis ..	Good as to life. Uncertainty as to the severity of the recurrent attacks	Good as to life. Recurrent attacks do not pass on to suppuration
Treatment ..	External drainage may be required	External drainage not required

Treatment

Pneumococcal parotitis presents many of the therapeutic problems of the other types of pyogenic parotitis. The principles underlying treatment have been discussed in

an earlier communication (Payne, 1938). Because, however, of the element of uncertainty which is inseparable from pneumococcal infections, treatment must be undertaken in the light of the natural history of the disease, and that of the risk of acute complications at any stage of the common recurrent type. Pneumococcal infections of the parotid thus present many of the problems both of acute and of recurrent parotitis. In no case must the treatment of the individual patient be undertaken without the fullest investigation and, so far as possible, a determination of the nature and extent of the pathological changes in the gland and in the duct system. The anatomical situation of the parotid and the important structures which pass through the gland render any drastic surgical procedure out of the question. In the present section the possible lines of therapeutic approach are briefly indicated, and the special points of difference between the therapy of pneumococcal and other forms of pyogenic parotitis are stressed.

Conservative and Local.—During the acute disease or during the acute exacerbations of the recurrent disease the object of conservative and local measures is to maintain or restore the patency of the duct, to empty the duct system of secretion, and to render the secretion more watery. These results can often be brought about by systematic and regular forward massage of the parotid, by duct catheterization, and by the use of external dry heat and frequent hot mouth-washes, and by giving the patient a diet as solid as he can possibly manage in order to maintain parotid function.

Duct Dilatation.—Regular dilatation of the duct may be valuable in those recurrent cases in which there is reason to suppose that the main duct is unduly narrow.

Duct Operation.—This involves a two-stage operation on the parotid duct from within the mouth, followed by prolonged daily dilatation in order to give a wider channel and ensure good drainage into the mouth.

External Drainage.—This will only be required when suppuration and abscess formation are present in the gland tissue. Since it is impossible on clinical examination to determine the site of the abscesses, the exposure of the gland and its drainage should be carried out in exactly the same way as in the cases caused by the *Staph. aureus*, described elsewhere.

Duct Operation and External Drainage.—A combination of these two operations is required when there is evidence of duct obstruction in association with deep suppuration in the gland.

Gland Obliteration.—In some of the worst cases of parotitis functional obliteration of the gland may follow duct operations. This is likely to occur only when parotid secreting tissue has already been largely destroyed by prolonged suppuration. The adequate drainage following operation allows the parotid duct system to become completely obliterated by scar tissue, which extends to and involves the duct orifice. Unfortunately there is no certain means of obtaining this result.

Auriculo-temporal Avulsion.—I have not employed this operation in any of the pneumococcal cases. In a *Strep. viridans* case in which this operation was carried out on both sides there was considerable temporary improvement, but twelve to eighteen months later the nerves regenerated and the symptoms recurred.

Chemotherapy.—In the pneumococcal cases sulphapyridine should certainly be tried, but as yet I have not been able to eradicate an infection by this means. In some of the earlier cases optochin hydrochloride was used as a local bactericidal agent.

Irradiation.—The use of deep x-ray therapy is certainly effective in some of the cases of parotitis caused by the *Strep. viridans*, and it is often remarkable how rapidly it acts in reducing a gross degree of parotid enlargement. The x rays apparently act by diminishing the secretion of mucus, and this lessens the tendency to duct obstruction. This method is much less certain in its action in the pneumococcal cases, possibly

owing to the much grosser changes which are often present in the gland and in the duct system. On these grounds and also because the pneumococcal cases tend to give rise to deep suppuration I believe that x rays should be used cautiously. Attempts to produce gland atrophy by means of irradiation are not justifiable.

It is obvious that there is no one single line of attack in these cases of pneumococcal parotitis. Each case must be considered individually in the light of the available evidence. It is also important in all cases to eradicate any local or adjacent cause of infection and to be entirely satisfied about the dental condition and the efficiency of mastication. The dental factor is of paramount importance in the recurrent and chronic cases, and no patient is likely to get rid of his infection unless the function of chewing is normal.

Prognosis

Acute pneumococcal parotitis is never of a fulminating type and the immediate prognosis as to life is always good. The recognition that a case of parotitis is pneumococcal and not due to the *Staph. aureus* should be enough to warrant that the worst features of pyogenic parotitis are unlikely to develop. Most of the acute pneumococcal cases resolve with conservative treatment and usually give rise to no sequelae. In none of the four acute cases here recorded was an external operation necessary, but in one case it was seriously considered. In this case the acute process eventually resolved, but the infection persisted in a milder form. The prognosis in the recurrent cases must be more guarded. In many the course is relatively benign and is similar to that of the *Strep. viridans* cases. But in some the recurrent attacks are of a very severe nature, pass on to suppuration, and necessitate external drainage. These pneumococcal cases possess an inherent element of risk which it is always difficult to assess. The majority pursue a benign course, while the minority pass on to suppuration and to a clinical picture up to anything short of the most fulminating type of *Staph. aureus* parotitis. The prognosis in the chronic cases does not differ from that in the recurrent ones. In the only chronic case in the present series there was the additional complication of an external parotid fistula.

Summary and Conclusions

Pneumococcal parotitis is a clinical entity possessing many characteristic features. It may occur in an acute, recurrent, or chronic form. Bacteriologically the largest group of pyogenic parotitis is caused by the *Staph. aureus*, which gives rise to the acute disease; the second largest group is that caused by the *Strep. viridans*, which gives rise to the typical recurrent condition; while the third largest is that due to the pneumococcus, and this group possesses features of both the acute and the recurrent disease. The pneumococcal group is the least well recognized of the three main types of pyogenic parotitis. The recognition of the bacteriological type in pyogenic parotitis has important bearings upon therapy and prognosis.

A series of seventeen personal cases of pneumococcal parotitis is reviewed, and the aetiology, pathology, and prognosis are discussed. Aetiological importance of dental factors is stressed. The recurrent cases may start during infancy, during the period of the second dentition, or during the first half of adult life. The recurrent cases tend to be commoner in females, as is also the case with the *Strep. viridans* group.

The main pathological features are described, and the uncertainty of the course and the tendency to abscess

formation are stressed. The bacteriological findings are summarized. The main features of the acute, recurrent, and chronic forms are described. The largest group is the recurrent one, with some overlap of the other groups into this. The acute cases never pursue as fulminating a course as do some of the *Staph. aureus* ones. In the recurrent group the exacerbations tend to be more acute and more severe than those in the *Strep. viridans* cases, and at times pass unexpectedly on to suppuration within the gland and marked constitutional disturbance.

Suppuration and fistula formation are the only likely complications. In the recurrent cases the parotid saliva is characteristically profuse and tenacious, and contains pus and a large amount of mucus. The sialographic changes are described in the recurrent cases and are usually grosser in type than in the *Strep. viridans* cases. The various lines of treatment are outlined. The main differences between recurrent parotitis due to the pneumococcus and that due to the *Strep. viridans* are summarized.

Prognosis in all cases is good as to life. In the acute group fulminating cases do not occur, and although recovery is the rule the condition may pass into the recurrent phase. In the recurrent group the exacerbations at times tend to be severe, and there is always a considerable element of uncertainty as to the development of suppuration.

On the basis of the evidence presented it is suggested that the natural history of pneumococcal parotitis possesses many characteristics which distinguish it from the other common forms of pyogenic parotitis.

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ANAPHYLAXIS FOLLOWING ADMINISTRATION OF TETANUS TOXOID

BY

Air Vice-Marshal H. E. WHITTINGHAM,
 C.B.E., F.R.C.P.Ed., K.H.P.

• Royal Air Force

The prophylactic inoculation of man against tetanus was until recent years performed by giving a subcutaneous or intramuscular injection of tetanus antitoxin (3,000 units) during the incubation period of the disease, for preference soon after receipt of a contaminated wound. This procedure aimed at preventing the occurrence of tetanus by neutralizing any toxin formed by the organism, and often necessitated multiple injections at weekly intervals, as the immunity conferred was so short-lived. General reactions, collectively called "serum sickness," followed in about 10 to 15 per cent. of cases injected with sera concentrated by the ammonium sulphate method, and in approximately 2 per cent. of those given the modern refined and concentrated sera prepared by selective treatment with proteolytic enzymes. These reactions were usually of the delayed type, characterized by the occurrence of rashes, malaise, joint pains, and some pyrexia seven to twelve days after the serum had been injected; occasionally, however, when a small desensitizing dose of serum was not given as a preliminary measure, immediate anaphylactic reactions were seen, especially among individuals who had been inoculated with similar heterologous serum at least a week previous, and so had time to develop

hypersensitivity to the serum. Briefly, the main drawbacks to this type of prophylaxis were that the immunity given was only passive, partial, and temporary, lasting merely a few weeks, and that serum sickness was a common occurrence.

Advantages of Tetanus Toxoid

To overcome these defects tetanus toxoid was first adopted on a large scale for the protection of man in 1936, for the compulsory inoculation of the personnel of the fighting services in France. In 1938, following the researches of Major J. S. K. Boyd, R.A.M.C., this form of prophylactic inoculation was adopted in both the British Army and the Royal Air Force on a voluntary basis. Boyd's work confirmed the result of similar researches in many countries, notably in France, Germany, and the United States of America—namely, that inoculation with tetanus toxoid had the power to produce an active and relatively permanent type of immunity to tetanus.

To attain this degree of protection two doses of 1 c.cm. of tetanus toxoid are given subcutaneously at an interval of not less than six weeks. This dosage, as Boyd has shown, is as effective as the three-dose method used in France, and produced from 0.1 to 2 units of antitoxin per c.cm. of blood serum within a month of the second inoculation. The amount of antitoxin adequate to protect man against tetanus is, according to Sneath, Kerslake, and Scruby (1937), 0.01 unit per c.cm. of blood serum: this minimum protective quantity of antitoxin has been confirmed by various observers to be present in the blood of man in the majority of instances for a period of two years after immunization. Ramon and Zoeller (1933) found that even up to a period of five years after immunization the blood of man contained enough antiserum to protect against infection with tetanus. This work still requires confirmation; but it can be accepted as proved that for two years after immunization with tetanus toxoid the antitoxin content of the blood can be relied upon either to prevent the occurrence of tetanus or so to modify the infection as to guarantee cure with modern anti-tetanus therapy. Thus it is now possible to protect man against tetanus before exposure to the danger of contaminated wounds, whether in peace or war, instead of after wounding as hitherto.

As regards the danger of reaction following injection with tetanus toxoid, Boyd (1938) stated that the toxoid produces no general or local reaction. This statement was made as the result of limited experience and is correct in the majority of instances, but, from observations made on a large number of Royal Air Force personnel so inoculated, it has been found that general reactions, even to the extent of severe peptone shock or anaphylaxis, may sometimes occur. Thus, in the follow-up of 61,042 individuals immunized by the two-dose method of giving tetanus toxoid, fourteen cases, or 0.023 per cent., showed definite constitutional symptoms, and two of these—that is, 0.0033 per cent., or 1 in 30,521, of those inoculated—had immediate anaphylactic crises, as shown in the accompanying table and detailed below. All these general reactions resulted from the second injection, which was given about six weeks after the first, and came on shortly after inoculation, usually within a half to one hour; it is thought that these reactions were due probably to peptone shock, as individuals subsequently tested by the scratch method showed hypersensitivity to Witte peptone, which was a constituent of the tetanus toxoid administered. The toxoid used in every case recorded here was the standard preparation supplied by Messrs. Burroughs