viously instructed, except that the length of the bars must not reach higher than to a position half an inch below the head of the fibula. Fit the bars into slots in the foot, as indicated in Fig. 3.

Socket.—Procure a piece of strong leather—length, from above the bulb of the stump to below the head of the fibula; breadth equal to the circumference of the stump. Rivet this leather to the inner sides of the bars. Insert eyelets for lacing the socket. The end of the stump, which is not enclosed, rests on a soft pad on the top of the artificial foot. Line the socket down the front with felt, or similar substance.

CHOPART'S AMPUTATION.

This amputation only requires the patient's boot to be filled up with firm stuffing to replace the lost portion of the foot.

THE TREATMENT OF PNEUMONIA IN CHILDREN BY SUBCUTANEOUS OXYGEN.

BY

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THE active treatment of pneumonia has long been augmented by the administration of oxygen. Those of us who have given the gas by intranasal catheter or inverted funnel have advocated it for its psychological rather than for its therapeutic benefit.

The value of oxygen administered subcutaneously has been by no means definitely authenticated, and therefore, with the object of investigating the immediate effects on the patient, and the more lasting effect on the course of the illness, 179 children admitted to my wards in Booth Hall Infirmary, Manchester, between November, 1928, and April, 1929, were treated with relatively large doses of oxygen injected into the subcutaneous tissues. Each case of acute pneumonia, irrespective of the type, etiology, or severity of the disease, coming under my care received oxygen as early as possible. It should be observed that the ages of the children varied from a few weeks to 16 years, and that the hospital recruits its patients from poorer-class Manchester districts where in winter child debility is widespread.

As a control, I have made notes on 89 consecutive cases admitted to Dr. I. A. Milne's wards during the same period to which subcutaneous oxygen was not administered.

In each series simple expectorant and counter-irritant remedies were employed as seemed indicated in each particular case. All were nursed in open-air pavilions in charge of the same sisters. To my regret, several patients who had received treatment were removed by parents before recovery was complete.

Dosage.

Mr. T. S. Kirk¹ found that the area of skin raised from the chest wall by 100 c.cm. of oxygen slowly injected was equal to the area covered by the palm of a man's hand. This rule was found to be fairly accurate, and was followed in this series, 50 to 200 c.cm. being injected at a time. Generally two or more doses were given. If on the day following the first treatment the temperature had not fallen, or if it had fallen and then became raised, as was a frequent occurrence, a second dose was administered. The average aggregate dosage was: up to 5 years of age, 200 c.cm.; from 6 to 10 years, 300 c.cm.; from 10 to 16 years, 400 c.cm. It was interesting to remark that whereas the absorption commenced in a few minutes, an oxygen emphysema was almost invariably felt for twenty-four hours or longer.

Method.

Rubber tubing was connected up to a cylinder of oxygen, and, with aseptic precautions, the gas was allowed to escape slowly through a hypodermic needle under the skin. About five minutes were taken to run in 100 c.cm. Specially warmed oxygen appeared to be without additional advantage. The hypodermic puncture was sealed with collodion, as the oxygen readily escaped. This simple procedure was unconnected with pain or discomfort, older children describ-

ing the sensation as similar to that produced by water trickling over the skin. In no case was there associated shock or other general disturbance, or abscess formation.

Immediate Effects.

Within four hours after the injection the temperature, as a rule, fell—sometimes to normal. This was accompanied by a partial fall in the pulse rate. The lowering in the pulse and respiration rates was less obvious than the temperature fall. Dyspnoea was eased. If cyanosis was a feature, within an hour the colour was improved. In four cases of pulmonary tuberculosis with cyanosis treated by this method a similar phenomenon was noted. Unfortunately, in all four relief was transitory, and the course of the disease either was not affected or it was expedited. No improvement occurred in the congestion of the face of a girl suffering from acute rheumatic myocarditis. The patients soon became less distressed (roughly in four to twelve hours), and as a rule slept comfortably. On the following day the general condition was improved except in some of the fatal cases. In no case did a crisis take place, the temperature falling by lysis.

In the first 50 cases—where it was possible without interfering with sleep—the temperature and pulse and respiratory rates were taken half-hourly for forty-eight hours. Nothing other than the remarkable variability in these phenomena was noted.

An early necropsy was performed on the body of a patient who died a few hours after administration. There was no evidence of oxygenation of the pulmonary tissues; the blood was dark, the bright redness described by Mr. Kirk not being observed.

Death Rate.

The following table indicates the percentage death rates in the various types of pneumonia.

	Oxygen Series.		Control Series.	
	Number.	Death Rate	Number.	Death Rate
		Per cent.		Per cent.
Total number of cases ...	179	25	83	25
Broncho-pneumonia ...	130	33	54	33
Lobar pneumonia ...	49	2	35	2
Primary pneumonia ...	121	23	71	20
Secondary pneumonia ...	58	28	18	33
Influenzal pneumonia ...	22	9	7	14

It is thus apparent that it cannot be claimed that the use of subcutaneous oxygen has a beneficial influence on the mortality.

Late Effects.

Pyrexia.—The average length of the febrile stage was shorter in the oxygen group.

	Oxygen Series.	Control Series.
Average length of febrile stage in all cases ...	10 days	13 days
Average length of febrile stage in broncho-pneumonia	10 days	15 days
Average length of febrile stage in lobar pneumonia ...	11 days	11 days

Duration.—The average length of the course of the disease was lessened in the oxygen series. The criterion of this was taken as the interval of time elapsing after onset before the chest was definitely cleared of adventitious sounds.

	Oxygen Series.	Control Series.
Average time in which chest cleared in all cases ...	23 days	29 days
Average time in which chest cleared in broncho-pneumonia	21 days	31 days
Average time in which chest cleared in lobar pneumonia	21 days	26 days

Conclusion.

From the cases investigated it was to be concluded that, whilst the injection of subcutaneous oxygen in pneumonia is without effect on the death rate, there is an immediate improvement in symptoms, with a curtailment of fever. The actual course of the disease itself is shortened by six or seven days. The reduction in the febrile period, and in the course of the disease, is more definite in broncho-pneumonia.

The definite alleviation of the toxæmia is not peculiar to pneumonia and seems quite apart from any specific action on the lung tissue *per se*. The toxæmia in a case of severe diphtheria was greatly relieved after injection of oxygen.

As a whole the pathological processes are apparently expedited. Possibly the stages of hepatization are hastened by an early formation of hydrogen peroxide in the pulmonary tissues.²

To the medical superintendent, Dr. J. D'Ewart, my thanks are due for permission to make use of the cases investigated.

REFERENCES.

¹ Kirk: *British Medical Journal*, August 4th, 1928, p. 195. ² J. W. McLeod: *Bacteriology of Pneumonia*, *Encyclopaedia Medica*.

BACTERIOLOGY OF THE TONSILS IN RELATION TO RHEUMATISM IN CHILDREN.*

BY

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It has often been suggested that the infective agent in rheumatism, in regard to which streptococci have more often been incriminated than any other organism, is to be found in the tonsil. Whether it exerts its toxic influence from there, or whether it enters the body by that portal, and is then disseminated to other parts, has not yet been decided. If, however, specific streptococci are to blame, and their *locus* of rest or passage is in the tonsil, one would expect to find some difference in the streptococcal flora of the tonsil in rheumatic and non-rheumatic cases. To determine this point a number of rheumatic and non-rheumatic tonsils were investigated. The rheumatic tonsils came from out-patients with articular rheumatism, chorea, and heart conditions, all of whom had some degree of enlargement or sepsis in their tonsils. The non-rheumatic patients were those in whom the tonsils were enlarged or septic, and from whom no history of any rheumatic manifestation could be elicited. In each case an endeavour was made to isolate all the varieties of streptococci present in each tonsil so that the types might be compared.

Analysis of Streptococci from the Tonsils of Rheumatic and Non-Rheumatic Children.

	Rheumatic.	Non-Rheumatic.
Total tonsils	50	48
Total streptococci	190	157
Streptococci per tonsil	3.80	3.27
Haemolytic	14.1%	14.03%
Non-haemolytic	85.9%	85.97%
Green	46.3%	45.86%
Non-green	51.0%	53.51%
Doubtful	2.7%	0.63%
Mitis	44.2%	37.0%
Salivarius	26.3%	28.0%
Faecalis	4.2%	3.18%
Pyogenes	12.6%	11.5%
Other streptococci	12.7%	20.0%

From this table it will be seen that the streptococci from the rheumatic tonsils do not differ materially, as regards the characteristics investigated, from those of the non-rheumatic. There is at present no really satisfactory classification of non-haemolytic streptococci, and this makes it difficult to draw a hard-and-fast line between varieties. Classification by means of sugar fermentation is not much to be relied on, and therefore, though we put in comparative differences in this particular, we fully realize its limitations. As, however, the conditions were always identical for cultures from the rheumatic and non-rheumatic series, even these variable tests should be of some assistance.

* The investigations upon which this paper is based were carried out by one of us (R. A. M.) during tenure of the Ida Sebag-Montefiore Research Fellowship at the Hospital for Sick Children.

The appearance of the culture plates showed no marked difference, and even on Crowe's medium,¹ which shows the minutest changes in colony appearance, we were unable to tell a rheumatic from a non-rheumatic plate. As regards the number of streptococci isolated per tonsil, this is rather low, owing to the fact that in one case in each series there were no streptococci found, in one or two almost a pure growth of one variety, and also that in a few cases the organisms died before any of their reactions could be carried out. This, however, was the same for both series.

Most observers—Poynton and Paine,² Small,³ and Birkhaug,⁴ to mention only a few—who have described "rheumatic streptococci," have placed them in the non-haemolytic and non-green-producing group. Without trying to isolate any of these recognized varieties, it might be expected that rheumatic tonsils would show a higher percentage of inert streptococci. There was little difference in our series, the rheumatic being slightly lower. This is in agreement with the work of Hitchcock,⁶ who found no greater incidence of inert streptococci in rheumatic fever throats.

Discussion.

For many years tonsillectomy in rheumatism has been advocated. Poynton and Paine (1900)² demonstrated their diplococcus in rheumatic tonsils, and in 1913 Poynton⁷ says that unhealthy tonsils are very frequent in rheumatism. Again in 1925⁸ he says that he believes successful removal of unhealthy tonsils to be a valuable prophylactic step in rheumatism when viewed on broad lines. Schichold (1910)⁹ claimed that removal of the tonsils cures the attack and prevents recurrence, and Hutchison (1911)¹⁰ upholds his view, if not quite so emphatically. Pybus (1915),¹¹ Morris (1916),¹² and Langmead (1920)¹³ all consider that tonsillectomy is advantageous, and in more recent years the British Medical Association report (1926),¹⁴ Robey and Freedman (1927),¹⁵ Kaiser (1927 and 1929),¹⁶ and Wilkinson and Ogilvie (1928)¹⁷ all recommend tonsillectomy.

From the observations of the above-named authors it would seem that rheumatic infection has a close connexion with the tonsil, and certainly any workers who have described definite streptococci as possible causes of rheumatism have been able to isolate the organisms from the tonsil. A number of different varieties are described, none of which seems definitely established, or is regularly isolated from every case. Birkhaug⁵ made a considerable advance when he succeeded in preparing a soluble exotoxin from his non-methaemoglobin-forming streptococcus, and he published some interesting results of skin tests which gave a much higher incidence of positives in rheumatic than in non-rheumatic children. This finding has not, however, been definitely corroborated in this country. Indeed, Mackie and McLachlan (1927)¹⁸ state that "the ability to produce toxic filtrates seems to rest in some peculiarity of this type of micro-organism" (streptococci), "rather than in a specific etiological role in respect of rheumatic fever."

To review briefly some of the results of earlier experiments, Cole, in 1904,¹⁹ produced arthritis and endocarditis in rabbits by inoculation of streptococci from various sources, not necessarily rheumatic; and in 1913 Harrison²⁰ states that inoculation of "non-rheumatic" streptococci will produce arthritis, at times indistinguishable from that produced by *Streptococcus rheumaticus* (Poynton and Paine). Faber in 1915²¹ produced a sensitization by giving more than one injection, and obtained arthritis in animals with a comparatively non-pathogenic green-producing streptococcus. Rosenow (1914)²² isolated three different types of streptococci from joint fluids in fourteen rheumatic cases. Swift and Kinsella²³ showed in 1917 that there were considerable immunological and cultural differences in streptococci isolated from their series of rheumatic fever cases. Clawson (1925)²⁴ isolated green-producing streptococci from twenty cases of well-defined acute rheumatic fever, and Andrewes, Derick, and Swift (1926)²⁵ found haemolytic, non-haemolytic, and *viridans* streptococci in acute throats in association with rheumatic fever. The researches of these workers show a considerable diversity of possible causal agents in rheumatism, and they have isolated in most cases streptococci which are to be found