SOME INFECTIONS OF THE TONSILS.

ABSTRACT OF THE HUNTERIAN LECTURE DELIVERED BEFORE THE ROYAL COLLEGE OF SURGEONS OF ENGLAND ON FEBRUARY 19TH, 1915.

BY FREDERICK C. PYBUS, M.B., M.S.DURH., F.R.C.S.ENG.,

HUNTERIAN PROFESSOR, ROYAL COLLEGE OF SURGEONS OF ENGLAND; SURGEON TO THE HOSPITAL FOR SICK CHILDREN, AND SURGICAL REGISTRAR TO THE ROYAL VICTORIA INFIRMARY, NEWCASTLE-ON-TYNE.

Anatomy and Physiology.

THE faucial tonsil, which lies between the pillars of the fauces, is the most complex part of the lymphoid tissue at the entrance of the alimentary canal. Lymphatic vessels pass from the tonsil to a gland in the deep cervical chains. Although afferent lymphatics have not been demonstrated, pigment injected into the nasal mucous membrane has been found after a short interval in the substance of the tonsil. Certain authorities ascribe some particular internal secretion to the tonsil, but on evidence by no means conclusive. The tonsils may serve as lymphatic glands for certain regions of the nasal cavities. They act also as a protection against the constant presence of organisms in this part of the pharynx—either in the mouth, lacunae, or tonsil substance—should they reach it through some breach in the surface. It is also probable that in the exercise of this phagocytosis they confer some immunity against the organisms inhabiting this region.

Bacteriology.

Both the surface and the lacunae of the tonsils are subject to organisms throughout life. No active invasion is apparent under normal conditions, but infection with very varied effects takes place under the influence of local injury or lowered resistance. Dwyer, in the examination of perfectly healthy subjects, found the pneumococcus, staphylococcus, *Micrococcus catarrhalis*, the diphtheria bacillus, the influenza bacillus, the spirillum, and other pathogenic forms on cultural examination of the contents of the lacunae, while the streptococcus seemed almost constant. In pathological conditions the balance is more or less upset, and additional organisms such as *Bacillus tuberculosis*, the *B. coli*, and actinomycosis, are present. The lecturer explained at length the different ways by which the organisms reached the tonsil so as to set up infective changes. *Actinomycosis* has certainly in some cases been conveyed in grain, but recent investigations have shown that the organism responsible for the disease occurs in milk, and it has been demonstrated that some cows considered clinically to be suffering from tuberculous udders were found on more careful examination to be affected with actinomycosis. As for *Syphilis*, it has been estimated that 10 per cent. of primary extragenital sores make their appearance on the tonsil. *Tuberculosis* in relation to the tonsil is most important. Unfiltered air, and dust which carries the tubercle bacillus, and infected food, especially milk, passes by the tonsils. These organs may become tuberculous, but it is almost impossible to distinguish a tuberculous tonsil clinically, excepting by its effect—namely, infection of the cervical lymphatic glands. In 70 per cent. of children with this condition the tonsillar gland is either alone involved or is the most enlarged, yet the tonsil rarely in such cases causes symptoms apart from glandular infection; a natural cure is the rule, but the infection may remain latent till middle life, till a tuberculous abscess appears in the region of the tonsillar gland. Mitchell, investigating 72 cases of tuberculous glands from children in Edinburgh, found that the bacillus was of the bovine type in 90 per cent., and of the human variety in only 10 per cent. The importance of a pure milk supply is thus manifest. When tuberculous infection is suspected, the tonsils should be removed entire in their capsule, the usual indication being tuberculosis of the tonsillar cervical glands. The tonsil, as the focus, should be taken away as early as possible, except where softening or abscess formation of the glands indicates that they should be dealt with first.

Streptococcus Infection: Rheumatism, Chorea, etc.

A constant inhabitant of the mouth, fauces, and tonsils, the streptococcus may live in apparent harmony with its host all through his or her life, yet it is probably the most important pathogenic organism in the tonsil. Its varieties are among the commonest sources of acute inflammation and of well-known complications, not only cervical bubo, but also endocarditis and septicaemia. The inflammation of the tonsil may subside, often recurring, and apparent pure hypertrophy in children is probably due in part to the presence of these organisms. The lecturer dwelt especially on that form of streptococcic infection which is associated with the production of rheumatism. The investigations of Poynton and Paine on the organism they consider the cause of rheumatism, and the later and additional work of Beattie, Dixon, Walker, and others, has shown that the organism found in acute rheumatism, although appearing in the lesion as a diplococcus, on cultural examination grows in chains, and belongs to the streptococcus group. The evidence that this organism is the chief causative agent in the production of acute rheumatism is accumulating, and its acceptance amongst the profession is increasing. Rheumatic fever and recurrence of rheumatic attacks are often preceded by an attack of tonsillitis. The presence of the streptococcus of the rheumatic type in the tonsil has been experimentally proved. The tonsil is affected in most cases of rheumatism, and lesions are detected there in persons dying of endocarditis, acute or chronic. The original case of Poynton and Paine was that of a patient with chronic endocarditis following an attack of tonsillitis. Characteristic organisms were isolated from the tonsil, and they produced endocarditis when inoculated into a rabbit. Repeated experiments by Poynton and Paine, and a later series of researches conducted by Beattie and Yates, support the evidence of the relation of the organism to rheumatism.

Material from various lesions in the joints, throat, and blood were examined in 192 cases, rheumatic and otherwise, for streptococci. The organism was obtained in 48. Seven of these cases presented a definite disease, and have no relation to the present question. Of the remaining 41 cases there was a rheumatic history in 31. The organism from these in 19 cases, or 61 per cent., on inoculation, produced typical lesions in rabbits, these lesions being characterized by acute non-suppurative synovitis. Of the 11 negative results in rheumatic cases 8 were from the tonsils. In each of these cases a single colony was subcultured, and there being many varieties of streptococcus present in the tonsil it may be presumed that a non-virulent form was obtained. If 2 additional cases, presumably rheumatic, are included, the positive results reach 70 per cent. in these cases, while in the non-rheumatic, typical arthritis was not produced in a single instance. In the experiments with organisms obtained from the tonsils of those with a rheumatic history—15 in number—a positive joint result was obtained in 7, or 47 per cent. Of inoculation from the tonsils where no history of rheumatism was obtained—5 in number—septicaemia was produced in 4 animals and arthritis in 1, the latter being possibly of the rheumatic type. A positive result was also obtained from the organism found in the cerebro-spinal fluid in a case of chorea. It has been shown that the organism from the tonsils of rheumatic patients is capable of reproducing in animals acute synovitis and endocarditis. The same organism has been found in other lesions of rheumatism, especially chorea. The *Diplococcus rheumaticus* has been isolated from 3 fatal cases of the condition by Poynton and Gordon Holmes, where it was found in the pia mater and endocardium. The histological characters of the brain lesion in these cases, together with the cultural findings, support the title given by these authors to this condition—namely, cerebral rheumatism. Chorea of pregnancy is, in the majority of cases, probably identical with that of children, as demonstrated by the experiments of French and Hicks, and of Wall and Andrews. In a patient under the lecturer's care an attack of chorea during pregnancy followed an attack of tonsillitis, and the tonsils and tonsillar glands were enlarged. The relation of hypertrophied tonsils to Sydenham's chorea has been investigated clinically by Branson, who found that of a series of 75 children 21 per cent. had been operated on for enlarged tonsils and glands.

Naso-pharyngeal lesions were present in 88 per cent. of these children with chorea, and 62 per cent. had enlarged tonsils, with enlargement of the corresponding lymphatic glands, or had undergone tonsillotomy. In 1910 the lecturer advocated the removal of tonsils for chorea where infection was considered to be occurring from them. This measure has been attended with considerable success, and has shown that the tonsil is one of the chief sources of infection, but that others exist in the naso-pharyngeal region, one case being unaffected by the operation until a chronic suppurating ear was cured. The removal of the tonsil cannot be relied on with certainty to cure the condition at once, but presumably cuts off further infection, for as in other rheumatic lesions, particularly endocarditis, the organism may remain latent in the affected tissues for varying periods.

There is also accumulating evidence that certain forms of chronic arthritis are related to infection from the upper part of the alimentary canal, in which the tonsil takes a share, as it is so much associated with oral sepsis. The lecturer added that the organism causing appendicitis, and in some cases actually coinciding with an attack of tonsillitis, may be derived from the tonsil, and he stated that he had observed acute neuritis following tonsillar inflammation. The nerve involved was not always the same; in his cases it was either the nerve of Bell, the anterior tibial, the descending branches of the third and fourth cervicals, or the musculo-cutaneous nerve of the arm. In one instance the attack occurred after incomplete removal of the tonsils, but since their septic stumps were removed, three years ago, there have been no further attacks.

Pneumococcus Infection.

The lecturer described the case of a child under his observation suffering from a large abscess in the region of the tonsillar gland. A pure culture of the pneumococcus was obtained from the pus, and also from the corresponding tonsil, which was removed at a later date; a small abscess containing the pneumococcus was found in its substance. The lecturer noted that several other pyogenic organisms have been observed to enter the system through the tonsils.

Specific Fevers.

The true or pseudo-diphtheritic bacillus may be a harmless inhabitant of the tonsil, or it may set up the characteristic lesion, yet remain limited to the tonsil. Once lodged in the lacunae, it is difficult to expel, and may cause repeated recurrences. The lecturer found this germ deep in the lacunae of a pair of tonsils removed after a third attack, and no recurrences followed the operation. Such a case imperils other persons besides the patient until it is cured. It has been shown that the infection of poliomyelitis may enter the system through the tonsils. The bacillus of influenza has been detected in the tonsils both of healthy persons and of patients subject to that disease, and tonsillitis may be associated with other specific fevers such as measles and German measles. Its relation to scarlet fever is so evident that some causal lesion between the two must be considered as established.

Hypertrophy of the Tonsil.

The Chief Medical Officer of the Board of Education states that of the six million children attending the Government schools 6 to 8 per cent. suffer from this condition to such a degree as to necessitate surgical treatment. The tonsil naturally enlarges after the age of 2 years, declining gradually in size after puberty. The hypertrophy usually corresponds with the period of decay of the milk teeth, and the year or so after the development of the permanent teeth. The main factor in causing hypertrophy is infection, due to the presence of the organism in the mouth and throat. The enlargement of the pharyngeal tonsil, with the consequent establishment of mouth-breathing, is a factor in the production of tonsillar hypertrophy. Mouth-breathing transfers to the mouth and throat the duty of filtering the inspired air, and, as the lecturer demonstrated, it produces dental caries. On the other hand, the reports of the Chief Medical Officer of the Board of Education demonstrated the beneficial effects of rendering the mouth clean. Hypertrophy often follows an attack of scarlet fever, diphtheria, or measles.

The enlarged tonsil varies greatly in size and shape; the pair often meet in the middle line, yet in some instances a tonsil may reach an extreme grade of enlargement without projecting beyond the anterior pillar of the fauces. Lymphoid tissue accumulates and germs infect the obstructed lacunae. When the infection subsides the tonsil tends to become fibrous and diminishes in size, but it remains septic and may continue to manifest its condition accordingly. Yet complete subsidence of the hypertrophied tonsil has been frequently detected on careful examination of long series of school children three months after previous inspection for enlargement of their tonsils.

In order to determine the condition of the tonsil as far as possible, in addition to mere inspection of the throat, the patient should be made to retch, when the tonsils are forced forwards and towards the middle line and stand out prominently. Under these conditions their exact size and shape can be determined. In order to judge of their septicity, if this is not manifest on simple inspection, the tonsillar fossa or lacunae should be explored with a bent probe. In all cases the tonsillar glands should be examined by palpation, while standing behind the patient, and in a large percentage will be found to be enlarged. Dr. Priestley, in his report (1910), showed the relation of enlarged tonsils to enlargement of the cervical glands. Amongst the commonest symptoms, repeated sore throats, tonsillitis, peritonsillar suppuration and enlargement of the tonsillar glands are the most important. Evidence of more general infection may be manifest, such as anaemia or endocarditis. In some of these cases the process was from the first insidious, with no history of acute tonsillitis.

The lecturer dwelt on 100 cases on which he had operated himself; 70 per cent. of the patients had suffered from attacks of tonsillitis or sore throat. The tonsils were considerably enlarged in 34 per cent. of the cases, moderately enlarged in 42. The remainder were judged to be of normal size or atrophic. In 96 per cent. the tonsillar lymphatic glands were enlarged—being definitely palpable in 82 per cent. In 14 per cent. the glands were sufficiently large to demand surgical treatment, and in 11 per cent. cases were considered tuberculous. In the remaining 20 per cent. the glands were moderately enlarged, being easily palpable, and in most cases visible.

Gross infection—shown by the presence of débris, pus, or foreign bodies—was found in 60 per cent. of the tonsils removed. Four cases had previously been operated on, and needed a second operation for tonsillitis or enlarged glands. For the removal of the 193 tonsils the guillotine was used in every instance; 95 per cent. of these tonsils were completely removed in their capsule, in one piece in the majority of cases; occasionally, however, owing to the size or shape of the tonsil, it was necessary to remove it in two or more pieces. The tonsils were definitely pedunculated in only 3 per cent. of the cases, the embedded type was present in 36 per cent., while the common variety, that with the projecting and almost solid lower pole, with the upper part hidden between the pillars and forming a cavity surrounded by folds of lymphoid tissue, was present in the remaining 61 per cent.

Treatment.

Where the symptoms are mainly or entirely mechanical and fail to subside in three months after removal of any source of infection, partial removal may suffice, but the basal portion of the tonsil may enlarge and again cause symptoms. Many hypertrophied tonsils, so far as can be ascertained on inspection, do not appear to be grossly infected, but in tonsils thus deeply infected the basal portion, often the most diseased, is left behind, and may commence to give trouble, especially if some of the lacunae become partially or entirely sealed up in the process of healing.

When infective symptoms predominate in the tonsil itself, such as acute tonsillitis, or chronic lacunar infection, or when the tonsils are in addition enlarged, any source of infection must be removed, especially carious teeth. Nasal breathing must be re-established, and the case watched to see the effect of the treatment. Where the tonsil is too severely affected to be capable of recovery, as judged by the recurrence of symptoms and the failure of the above measures, then total removal is indicated. Enucleation of the tonsil must necessarily prevent tonsillitis, and while it does not entirely prevent pharyngitis,

such attacks are, as a rule, materially lessened in frequency. When repeated quinsies have occurred, further attacks may be prevented by removing the source of the infection—namely, the tonsil. For lymphatic gland infections, where tuberculosis is suspected, tonsillectomy is indicated, and the course of the glandular enlargement determines whether more extended operative measures may be needed. In pyogenic infections of the glands the tonsil must be dealt with when the acute lymphadenitis has subsided or been operated on, if suppuration has supervened. Chronic glandular enlargement, of the mild or moderate degree, is so frequently met with in hypertrophied tonsils, that when the tonsil recovers its normal character the glands subside also. No tonsil should be removed when acutely inflamed. For more distant infections, when the tonsil is suspected of being the focus, removal is indicated when the general condition is satisfactory.

In all these cases total removal is the operation of choice; it presents no greater danger than incomplete removal, and can be readily accomplished by the guillotine alone, by a method first described by Mr. Whillis and myself in January, 1910. While these methods directed to the individual are of great importance, there is no doubt that prevention of tonsil infection should be our chief aim. This is to be obtained by the advances of hygiene—personal, in the home, and in the school. The maintenance of nasal respiration, the prevention of dental caries, and the proper supply of food, in sufficient quality and quantity, will greatly diminish the prevalence of this condition. The provision of a cleaner air supply and the prevention of infection by milk are measures needing attention. When that delicate balance between health and infection is upset, and the tonsil, a useful organ, becomes diseased and incapable of recovery, a timely removal of this focus may present more grave illness and disability. The question of infection of the tonsil and from the tonsil is not to be summed up in some form of operative procedure, but by attention to the numerous measures that have been indicated.

THE STERILIZATION OF THE SKIN WITH TINCTURE OF IODINE.

By J. LIONEL STRETTON,

SENIOR SURGEON, KIDDERMINSTER INFIRMARY AND CHILDREN'S HOSPITAL.

THE method of sterilizing the skin with tincture of iodine which was originated by me, and which was first described in the BRITISH MEDICAL JOURNAL, August 14th, 1909, was received, as I expected, with a considerable amount of scepticism. In spite of this, it has rapidly gained favour and is now very widely adopted. The remarks which I read from time to time in the press make it evident that some of those who use it are not thorough in their methods; some adopt alterations and some deny that the method is efficacious. At such a juncture it may be well for me to state my further experience, to amplify my description, to emphasize the importance of some of its details, and to reply to some of the criticisms.

I have now used the method in upwards of 3,000 cases. It is unnecessary to publish a detailed list of these. It includes most of the operations a surgeon is called upon to perform. Among these cases I have never seen a stitch abscess, and I feel confident that the skin was in all cases sterile. Of course, I only refer to cases in which an aseptic result can be expected. You can hardly blame your skin if you find a *Bacillus coli* infection after the removal of a quiescent appendix! Even in cases which are septic previous to operation the skin incisions heal more surely and more rapidly. My extended experience has increased my confidence to such an extent that I never have any anxiety of skin infection. Of course I do not claim that it will secure asepsis in all cases. There are many other channels of infection besides the skin, some of which we may never be able to control. The one which always appears to me the most difficult is infection from within. Take, for instance, traumatic effusions of blood which have no direct communication with the atmosphere. How often they become infected! Or injuries into a joint without any breach of surface where infection supervenes. If by any chance a surgeon had aspirated such a joint before it became infected, few would believe that the germs entered by any other channel than the wound which he inflicted.

The solution I originally used was the tincture of iodine (*B.P.*). It is prepared by dissolving 2½ per cent. of iodine and 2½ per cent. of potassium iodide in rectified spirit. In an endeavour to save the funds of the hospital I tried a solution of the same strength in methylated spirit, but I soon found that it produced so much irritation and lacrymation that I was obliged to resume the original compound. I now use the tincture in the theatre and a similar solution made with methylated spirit in the wards. It was probably my effort to save the hospital funds which caused another surgeon to imagine that he had discovered the rectified spirit solution. He evidently did not read my paper carefully, or he would have learnt that my original work was done with tincture of iodine (*B.P.*), which is made with rectified spirit.

The method of application is similar to that which I originally described. A wide area of skin is painted half an hour before the patient is brought into the theatre. It is allowed to dry, and is then covered with a sterile towel. When the anaesthetic has been administered another painting is performed. It would be more correct to describe it as a rubbing, for I now use a small swab held in a pair of forceps, with which I rub the solution over the surface, taking special care over the hairy regions. If there is any occasion to increase my incision or to make a new one beyond the limits of the application, a further rubbing is easily performed. The little swab is dipped into the wide-mouthed bottle in which the tincture of iodine is stored, and if a further application is necessary a fresh swab is used. This is preferable to using a brush which is constantly dipped into the bottle. It has the further advantage that the stopper can be immediately put into the bottle, and so prevent evaporation or contamination. If a brush is left standing in the bottle this is impossible.

When the operation is completed the line of incision and about an inch margin is freely swabbed with the tincture. A sterile gauze dressing is usually applied, but in some cases, especially after hernia operations in children, no dressing is used. In septic cases I have packed in gauze soaked with the tincture. In all after dressings a free application is made. As a rule, the wounds are not uncovered for a week, but occasionally more frequent inspection is desirable or dressings are not applied. In such cases I swab with the tincture every day and have never seen any ill effect.

All the casualty wounds at our hospital are treated with it. Immediately they are seen a free application is made. After the necessary exploring, trimming, and stitching is complete a second application is made before the sterile dressing is applied. The improvement in results in these cases is most remarkable.

My patients are now admitted to the hospital the day previous to the operation. This saves them from the harass and distress of waiting and from the former elaborate and alarming preparations. The house-surgeons and the nurses are saved an enormous amount of work, and the hospital is saved the large expenditure which was formerly necessary for preliminary preparations. In twelve months this would amount to a very considerable sum.

Various modifications have been practised. Some have adopted a 2 per cent. solution, some an acetone mixture, and some a colourless solution, while others either wash the skin beforehand or paint on various solutions. I fail to see any justification for these alterations. If tincture of iodine is efficient, why alter it?

It was suggested that it was necessary to insist on a fresh solution for fear of decomposition, and then it was discovered that the formation of hydriodic acid which occurs if a solution of iodine in spirit is kept for any length of time could be prevented by the addition of 2½ per cent. of potassium iodide. These observers either failed to read my original paper, which states tinct. iodi *B.P.*, or they forgot that the *B.P.* tincture contains 2½ per cent. of potassium iodide. If it is kept in a properly stoppered bottle, it will remain good for an indefinite time. If there is any evaporation, it becomes stronger and too irritant. Messrs. Oppenheimer have put it up in small