

The great sanitary hope of the future, however, lies in the health education of the child of today. It is true that the child can be more easily reached through the spoken word than can the adult; that the effect of stereopticon lectures and motion picture demonstrations is more lasting; that the sanitary and hygienic instruction received in the course of the curriculum will do much to make the child of today the sanitary, clean-lived citizen of tomorrow, but, as with the adult, the child must have an ocular demonstration of cause and effect in the prevention of disease and the up-building of health. This must begin with the kindergarten and extend through the graded school, the high school and the college. The subject must not be thrust to one side, used as a stop-gap to fill in a few idle moments. It must assume a place in the educational scheme equal to that now occupied by the three R's; if this is done, and done well, we will build a nation of strong, health-loving people, whose daily life is governed by a working sanitary conscience.

Throughout this address the use of the word publicity has been scrupulously avoided, because to the average mind the word publicity means newspaper exploitation. In the proper sense of the word publicity is the great aim of the public health education of the general public. We, as the sanitary profession, are much in the position of the manufacturer who has a certain article which he desires to market. He must first produce the article. He must be certain that it is a good article, and having arrived at this conviction he must create the demand for it by making the general public share his belief in its worth. We know what we can do in public health work. The general public does not know how much good can be done them. The task which lies before us is to so educate them that they will realize the good which can and will come from the observance of the laws of health. We must create in them a demand for public and personal hygiene, and if, through every medium, we keep this constantly before their eyes, hygiene and sanitation will become household words and rules of action. We would do well to study the methods which have been used in popularizing manufactured articles and to change the plan just enough so that it may better fit this important work which lies before us.

The American Medical Association has already accomplished much in this field. It must do more. It must further the cause of public health education, not only of the lay public, but of the profession as well. It must be a coordinating center of the volunteer educational efforts in order that the work may have a scientific, wholesome basis. We must harmonize and extend the movement. We must move forward with high ideals as the goal. It is suggested that this section take steps to bring to the attention of the Association the necessity for a public health exhibition in connection with our annual meeting, so that we may thereby leave the definite impress of our visit in the tangible form of better health and cleaner living. Ours is a great work. Its opportunities are as vast as the distribution of the human race; and if we but grasp those which are nearest to us, our lives shall not have been in vain. May the deliberations of this section hearten and inspire us for the task which waits us.

An Early Master.—I repeat then once more: a special germ, proper to each contagion, gives rise to each contagious disease. Epidemic scourges are only engendered or disseminated by their reproductive germs. In all ages, every tongue has spoken it.—Bretonneau, 1855.

THE NONSPECIFIC AND THE SPECIFIC DEFENSE OF THE CHILD AGAINST THE TUBERCLE BACILLUS*

FRANCIS M. POTTENGER, A.M., M.D., LL.D.

MONROVIA, CALIF.

Soon after birth children begin their contact with infectious bacteria. That they do not succumb to their attacks is due to a certain protective mechanism with which the child is endowed, whereby bacteria are destroyed.

Whether or not a given inoculation will be overcome, and the child go free from infection, or whether the bacteria will gain a footing in the tissues, multiply and produce their specific disease, depends on the efficiency of this natural defense. Sometimes the protection may be insufficient and may fail because of impairment of the defensive mechanism. If we did but realize the universal presence of pathogenic bacteria and the innumerable inoculations which take place in the tiny infant, we would have great respect for this protective mechanism with which the child is endowed.

In the first place, there are few portals of entry for bacteria. The skin offers an almost impenetrable barrier. The main avenues through which inoculation takes place are the nose and mouth, the bacteria entering the body along with air, food and drink. When bacteria enter through either of these portals they come in contact with secretions which possess bactericidal properties, and meet a mucous membrane which is not easily penetrated when healthy. There are also arranged here and there, at points of vantage, masses of lymphoid tissue, the cells of which are so arranged that the bacteria are more or less easily deposited within them. This lymphoid tissue contains the lymphatic elements, which have defensive properties in abundance; in fact, lymphocytes are formed within it. Should bacteria pass through the mucous membranes, or make their way beyond the lymphoid tissue, they are met by what might be termed an internal defense. Here they come in contact with the lymph and various body cells which have defensive properties. The protective elements are found both in the fluids and in the cells. While the leukocytes possess protective properties to the greatest degree, yet other cells have a part in the natural defense.

I desire particularly to call attention to the protective influence of the lymphatic system during these early years. If bacteria pass through the masses of lymphoid tissue, such as those in the throat or vault of the pharynx or those in the intestinal tract; or if they pass through the mucous membranes, they find their course by way of the lymph channels which drain that portion of the mucous membrane or those masses of lymphoid tissue through which the bacteria have passed to the lymphatic glands.

Lymphatic glands are the seat of leukocyte production. They are rich in lymph, consequently afford ideal conditions for destroying the invading bacteria. The importance of the cervical glands in screening out and destroying bacteria can be readily appreciated. Children of the poor, who live under bad hygienic conditions and suffer injury to their mucous membranes; who, because of their method of living, possess lowered resisting powers; and who, further, on account of the

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bad hygienic conditions which surround them, are subjected to more or less constant inoculations of large quantities of bacteria, suffer almost universally from enlargement of the lymphatic glands which drain the nose and mouth. This enlargement of the lymphatic glands is evidence of frequent and massive inoculations.

At the same time that we find enlargements of these lymphatic glands we commonly find enlarged tonsils and adenoids present. This enlargement of the lymphoid tissue is to be looked on as a reaction produced by the irritation of the bacteria. When we find an enlarged cervical gland and a corresponding enlarged tonsil, it does not mean that the tonsil is the cause of the enlarged cervical gland; consequently, immediate removal of the tonsil is not necessarily called for. It rather points to the fact that the tonsil was not able to destroy the invading bacteria, and that they have gained entrance in such large numbers that, in spite of its presence and its protective function, they have escaped through the tonsil and found their way to the gland, causing its enlargement. Neither does the enlargement of these cervical glands call for their removal. Very often the institution of better hygienic conditions results in improvement in the physical condition of the patient. In this event the child may overcome the infection and the gland may gradually return to its normal condition.

The importance of these glands is illustrated not only in the cervical group, but in the mediastinal group. The mediastinal group of glands bears the brunt of drainage in infections of the respiratory tract. In acute bronchitis, likewise in the bronchitis which accompanies whooping cough, measles, scarlet fever and smallpox, the bacteria often penetrate the walls of the bronchial mucous membrane and are strained out in the peribronchial and peritracheal lymphatic glands, sometimes producing enlargement to such a degree as to cause severe symptoms.

The enlargement of lymphatic glands in tuberculous infection in the child is well known. The enlargement of the glands of the neck when bacilli pass through the upper air passages, of the mediastinal glands when they pass through the mucous membranes of the bronchi, and of the mesenteric glands when they pass through the intestinal mucous membrane are all examples of infection; but, at the same time, these enlargements of the glands are visible evidence of a protective mechanism. In no tissue of the body are the natural defensive powers greater than in the lymphatic glands. The lymphatic structures are peculiarly active in childhood and gradually degenerate as age comes on. They are not so necessary after specific cellular defense against the various bacteria has been developed. It is significant that nature has so arranged it that the battle between the invading organisms and the child shall be fought in these structures prior to the time that a specific cellular defense has been developed.

I particularly wish to emphasize the importance of these lymphatic structures and this protective mechanism because of the tendency which is all too common today of ruthlessly sacrificing lymphatic structures in the throat and vault of the pharynx, without giving due consideration to their importance.

I am aware of the fact that tonsils and adenoids must often be removed; but I believe that the tonsillar and adenoid tissue, unless it is producing distinctly harmful effects, should be left in situ until the child has grown sufficiently old to have come in contact with

pathogenic bacteria in sufficient numbers to have developed a specific cellular defense against them. After this, the protection offered by the lymphatic structures is still important, but not so essential as during the earlier period of life.

The tonsil is also in great danger today because of the recent discovery of its importance as a focus of infection from which streptococcal metastases spread throughout the body, causing such affections as valvular heart lesions, chorea, and so-called rheumatism.

The teaching has gone forth that if we discover the primary focus of infection in a tonsil, and remove it, this will influence the metastases. I can see no reason for this being true. I can see, however, why the original focus should be removed to prevent further metastases and to relieve toxemia.

It seems quite evident that the lymphoid tissue gradually loses its protective importance. This occurs as the patient develops specific cellular defense against the organisms which are taken into the body; but, until this has occurred, such lymphatic structures as are found in the mouth and upper air passages should be preserved, if possible, in order to carry out their defensive function.

I also realize the manner in which these structures, when enlarged, produce injury to the ear, interfere with nasal drainage and favor infection of the upper air passages. I know that they will, at times, also produce cough and bronchitis; but I am fully convinced that many of the coughs and persistent attacks of bronchitis for which operations on tonsils and adenoids are done are due to enlarged bronchial glands, which are not removable, and to thickening of the bronchial wall, which have resulted from infections of these structures. Persistent colds of the nature of bronchitis call for a more extensive investigation than that of the upper air passages. Not only the tonsils and adenoids should be thought of, but peribronchial thickening and enlargement of the mediastinal glands, as well.

The importance of the lymphatic tissue, as emphasized in the discussion which I have given thus far, applies to bacteria in general, but with special emphasis to infections by the tubercle bacillus.

Tuberculosis is primarily a disease of the lymphatic glands. When the tubercle bacillus passes through the mucous membranes, prior to the time that infection has taken place, it finds itself in the lymph channels and is carried to the lymphatic gland which lies in the course of the lymph stream. There is no specific antagonism between the tissues through which it passes and the bacillus itself. No such specific inflammatory reaction takes place as is noted in later years. To be sure, many bacilli are destroyed by the bactericidal action of the lymph, but some will escape and find their way to the lymphatic glands. Those glands which are so placed in the path of drainage that they receive frequent inoculations of bacilli, now and then, find themselves unable to destroy the number which enter them, and become the seat of infection. Such infections may soon be overcome by the natural defensive properties of the lymph. If they are not, however, the bacilli multiply and produce a larger focus. As a result of this infection, toxic products are thrown out into the lymph stream, and are carried throughout the body. They find themselves, as Vaughan suggests, deposited in the tissues. Here they call on the cells to destroy them. As a result of this demand, a new function is awakened in the cells—that of destroying tubercle bacilli and their products. After the cells

have developed this property and taken on themselves a specific antibacillary defense, if bacilli become enmeshed in the tissues an inflammatory reaction occurs between them and the tissue cells, which is entirely different from the phenomena which appear prior to the time that infection has taken place. Prior to the time of infection the leukocytes and the body cells, as well as the plasma and lymph, act on the bacilli and destroy them. After infection, while the body cells and fluids still possess their nonspecific defensive properties, a specific defense is acquired by the fixed cells. Prior to the time of infection, if bacilli pass the mucous membranes and escape the antibacillary action of the lymph elements, they are carried directly to the lymphatic glands; after infection, on the other hand, they are retained in the tissues at the site of entrance and a specific inflammatory reaction is set up. Now the struggle for existence on the part of the tubercle bacillus and for its destruction by the tissue cells is fought out at the point of invasion; consequently, primary tuberculosis and metastatic, or superimposed tuberculosis, are entirely different processes. The protection is different. In one it is entirely nonspecific, depending almost wholly on the lymphatic elements. In the other it is both nonspecific and specific, depending not only on the lymph elements, but probably more on the acquired defensive properties of the fixed cells of the tissues to produce specific proteolytic ferments for the destruction of the bacillus.

In the child tubercle bacilli are often found in tonsils and adenoids. This does not mean that the tonsil and adenoid must be looked on as being sources of danger to the child. On the contrary, we must look on them as being masses of lymphatic tissue placed in these exposed regions where bacilli are apt to penetrate the mucous membranes, so that they may exert their protective influence in the destruction of such micro-organisms. The finding of bacilli in these structures means that they are passing through them and so far have not been destroyed. The finding of bacilli in the lymphatic glands which receive drainage from the tonsil and adenoid tissue shows that the latter have failed in the destruction of the bacilli, and that the micro-organisms have made their way into the deeper structures in spite of the fact that masses of lymphoid tissue have been interposed to destroy them.

The probabilities are that specific cellular defense is more active immediately following infection and during the time that the focus is active than it is some time after the infection has healed. This supposition is in accordance with clinical observation in tuberculosis. After the infection has occurred, except when the inoculation is a very large and very virulent one and the child's vitality is low, the patient is protected, for a time, from the occurrence of metastases. But after years pass by the number of metastases increase; and, by the time the second decade has been reached, we find tuberculosis spreading from these original foci and producing clinical tuberculosis in a large percentage of cases. This metastatic tuberculosis, however, differs greatly from primary tuberculosis. It shows a predilection for tissue other than glandular and assumes a chronic character even in these other structures. If, on the other hand, the bacilli are not retained in the glands of the little child prior to the time that infection has occurred with resultant specific cellular defense, acute tuberculosis will occur. The child at this period shows very little tendency to chronicity or to healing if the infection escapes from the

lymphatic glands. It is not until the cells have taken on themselves this specific property of defending the body against the bacillus that we find chronic tuberculosis present. But when this has developed, unless the secondary metastases are caused by too many bacilli, the resultant infection is, as a rule, mild in character. The bacilli do not find the soil congenial for multiplication; consequently, their growth is interfered with, and the disease takes a chronic course.

SUMMARY

1. Immediately following birth the child is protected by a nonspecific cellular and humoral defense.

2. After coming in contact with tubercle bacilli, the fixed cells take on themselves a new property, that of producing specific proteolytic enzymes, whose function it is to destroy tubercle bacilli and their products.

3. The nonspecific defense is carried on largely by the lymphatic system, collections of lymphatic tissue, such as tonsils, adenoids and Peyer's patches being placed here and there where bacteria are likely to gain entrance to the tissues, so that bacteria may be taken up by them and destroyed.

4. When bacilli pass through the mucous membranes or these masses of lymphoid tissue, prior to the time that infection has occurred, they are carried directly to the lymphatic glands, in which they are destroyed or held captive. If they withstand the action of the lymph elements, they form a tuberculous focus.

5. Practically all tuberculosis, prior to the time that specific defense is created, is confined to the lymphatic glands; the exception being when large numbers of bacilli are taken into the body and find their way directly into the blood stream, by which they are scattered through the body, producing generalized tuberculosis.

6. After specific defense has been established, bacilli no longer pass readily through tissues, but are hindered by the fixed cells. A specific inflammatory reaction ensues, and the bacilli are either destroyed, or, if not destroyed, prevented temporarily, or wholly, from spreading.

7. This defensive inflammation results at times in a stimulation of fixed cells and increased fibrosis, producing encapsulation; at other times, necrosis followed by ulceration and the expulsion of the tuberculous mass.

8. The lymphatic structures are extremely important in their protective rôle prior to the time that specific cellular defense has been attained; consequently, tonsils and adenoids should be spared to the small child, unless indications for their removal are absolute.

ABSTRACT OF DISCUSSION

DR. JOHN RITTER, Chicago: I am pleased to see this attempt to stop the promiscuous removal of tonsils. The tonsils proper and the lymphoid tissue all around, in fact, the whole Waldeyer ring, are really infantile organs and bodies, and they disappear about the fifteenth year, or about puberty, when they have fulfilled their purpose. As Dr. Pottenger has told us, this lymph tissue at the entrance stops the bacilli from infecting the body of the child. In the child we have chiefly tuberculosis of the glands but the bacilli usually do not pass very far from the glands of the mouth. When we have tuberculosis passing on into the bronchial glands, then we know that undoubtedly some of those bacilli have passed through the trachea into a bronchus and have pressed onward into the lung proper or into the mediastinal glands. This is the type of tuberculosis peculiar to children. I am emphasizing once more the need for care in diagnosing pulmonary tuberculosis

in children. Pulmonary tuberculosis is much more fatal in childhood and much more acute than in the adult. We see very little pulmonary but a great deal of bronchial gland tuberculosis in children. The thing for us to do is to emphasize particularly the guarding of the entrance of the throat and to save the tonsils and to spare this guarding lymphoid tissue as long as we can. When a tonsil is diseased, full of openings and crypts, then bacilli may get in and be held there and cause disease; still they should be treated and taken care of, and should not be removed until absolutely necessary. In a great many cases where the tonsil has been removed, four, five or six months afterward we find active pulmonary tuberculosis. We may cause activation of an old process or the favoring of a latent into an active process by lowering of body resistance.

DR. JOHN ZAHORSKY, St. Louis: We must recognize in children a physiologic process of acquiring immunity to all pathogenic germs. The tonsils make the child immune to a great variety of infections. Infections of the nose, throat and glands are very common in young children. After they get to the age of 8 or 9 they are less susceptible—they are able to resist the infection. A very young baby has to go through all sorts of reactions to become immune. The tonsils are the first line of defense. If you remove much of the Waldeyer ring you have a greater susceptibility of the deep structures, particularly the lungs. In the case of a young child suffering from large tonsils and repeated sore throat, if the tonsils are removed, afterward he would have bronchitis and bronchopneumonia rather than tonsillitis. We must conserve Waldeyer's ring. We must learn to treat the tonsil, not remove it. If infected with pus, get the pus out, but do not remove the tonsils if it can be avoided. The young child needs its tonsils. The pediatricists should say whether or not they should be removed.

DR. J. I. DURAND, Seattle: The tonsil is a lymphatic gland which through some developmental fault has been opened to the exterior instead of being covered as all other glands are. The original tonsil must have been submerged. In the present condition the tonsil is wide open, in a position to be infected readily. Every crypt in the tonsil may become a culture tube in which bacteria and toxins are elaborated, to threaten the organism. I do not believe in taking out all tonsils, but it is often difficult to tell when they should be removed and when not. I am inclined to think we err too often in not taking them out. The tonsil is undoubtedly one of the organs of defense, but it seems to me that a perfectly smooth wall of scar tissue is a better defense against infection than a wide open gland such as the tonsil. Again does our clinical experience carry out this idea that the tonsil is put there to be a perpetual source of vaccination and bring immunity in that way. Do we not see less infection in children who have had the tonsils removed? Is it not our experience that the general resistance of the child is increased after removal of the tonsils? If the tonsil is simply a lymphatic furnishing the first wall of defense against infection, why are not the bronchial glands just as good?

DR. ST. GEORGE T. GRINNAN, Richmond, Va.: In Richmond there are about 40,000 negroes. We have a negro dispensary there, and I do not think I have ever seen more than one or two cases of tonsillitis in young negroes over 6 or 8 years old. There is a large percentage of tuberculosis of the lungs. Some time ago I saw a young negro with a temperature of 104 F. He had extremely extensive tuberculosis of the lungs. There was another child about 3 years of age. I asked the mother if the other child was sick, and she said "No." I took its temperature and it was 104 F. She died first. We have much tonsillitis there among the white people. It is rare to find tuberculosis of the lungs among the younger white children. A large number have glandular tuberculosis, particularly at the angle of the jaw and the cervical glands.

DR. F. P. GENGEBACH, Denver: I would like to ask Dr. Pottenger how much importance he attaches to the persistent enlargement of the anterior cervical glands? I appreciate that we cannot always tell by the appearance of the tonsils whether they should come out, but I do consider the persistent enlargement of the cervical glands of importance. I also want to ask as to the value of removal of the tonsils in cases of tuberculous adenitis.

DR. C. G. KERLEY, New York: Dr. Pottenger is rather lenient with a diseased tonsil. A tonsil that is capable of harboring tubercle bacilli or any other bacteria should to my mind be removed, regardless of the age of the patient. I prefer that tonsils be not removed in very young children if it can be avoided with safety to the patient for the reason that the results of enucleation of the tonsils in the very young have not always been brilliant in my patients. The tonsil performs a function in the development of the throat. I have seen adhesions of the pillars and deformities result when early tonsillectomy had been performed. A point regarding adenoids and the presence of diseased tonsils is frequently overlooked. In diphtheria, measles, scarlet fever and influenza, they furnish a favorable culture field for infection which we always have in the throat. It is the child with adenoids and diseased tonsils who gives us our cases of acute otitis, mastoid diseases and sinus thrombosis, therefore as a prophylactic measure, enucleation of diseased tonsils and adenoids is to be advised regardless of their effects in other ways. I have never seen a case of tuberculous adenitis in a child whose tonsils were properly removed. I refer, of course, to complete removal of the tonsil and capsule.

DR. F. M. POTTENGER, Los Angeles: Dr. Kerley states that when a tonsil has been properly removed he has never seen a case of tuberculous adenitis in the cervical glands which receive drainage from that organ. I look on the infection of a gland where the bacilli have passed through the tonsil as indicating that the bacilli have simply passed through the first line of defense and taken the second trenches. It does not mean that the tonsil is a factor in causing the infection, but that, in spite of the tonsil, bacilli have been able to break through to the glands. I agree with Dr. Kerley absolutely in his attitude toward tonsils which are definitely diseased. They must be removed unless the focus can be removed otherwise. Answering Dr. Gengenbach's question, if I had a patient with persistent enlarged glands which were giving out bacteria into the deep structures and producing metastatic infection, the infection would have to be relieved or the gland removed. The principal defense of the child at birth is in the lymphoid structures which manufacture lymphocytes; but, as he gradually comes in contact with various bacteria, he immunizes himself. He builds up a specific power in his cells to overcome bacteria. The lymphatic structures manufacture leukocytes and are the greatest protective factors during this early period when the specific defense is absent, and we ought not ruthlessly sacrifice them. We ought to give the child this protection as long as necessary. It has been mentioned that the tonsils are open glands, and, from their structure they are apt to be infected, and consequently are sources of danger. What about Peyer's patches? We do not take them out, yet they are open glands. It is possible that these glands are furnished with crypts that they may take in bacteria more readily; because there is no place in the body of the little child where bacteria can be destroyed so readily as in these lymphatic structures. They become infected; but, as a rule, they do not become seriously infected until the time when they are no longer necessary to the defense of the child. Their period of greatest activity is when the child needs it most. After the child has come in contact with the various infectious bacteria and built up his specific defense, the lymphatic tissue becomes less important and atrophies. The point that I wish to emphasize is, if possible, the child should be given advantage of the natural protection furnished by the lymphoid tissue, until specific defense has been attained. If the tonsils and adenoids become infected and become sources of metastatic infection they must be removed. If they make pressure and threaten injury to the ear, or interfere with nasal drainage, it may be necessary to remove them, but they should not be removed in the small child without cause. I would not remove the tonsils in case of tuberculous cervical adenitis. We rarely see tuberculosis of the tonsil, and when we do it is usually an accompaniment of an advanced generalized tuberculosis. When tonsillar tissue shall be removed it is a subject that requires judgment. Each case should be considered by itself; but the rule should be to give the child the benefit of this protection until he is able to build up the specific cellular defense which protects him in later life.