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Address.

TUBERCULAR INFECTION IN INFANCY AND CHILDHOOD.*

BY VANDERPOEL ADRIANCE, M.D., WILLIAMSTOWN, MASS.

IN the bulletin of the Massachusetts Trustees of Hospitals for Consumption, December, 1913, it was stated: "The importance of childhood infection is coming to be recognized as a most important factor in anti-tuberculosis work. The Board wishes to impress upon physicians and anti-tuberculosis workers throughout the State the absolute necessity of recognizing and treating tuberculous infection in children if we are ever going to make any headway against the disease. There is too much of a tendency to wait until people become sick before we cure them. The bulk of patients at present under treatment in our sanatoria represents the results of infection when they were children."

On August 1, 1914, the same Trustees sent to each physician of the Commonwealth a letter which said:

"It is your opportunity, first, to protect these children from infection, and second, to see that they are cared for when such infection has taken place. If you delay making a diagnosis until actual disease is evident, the case has probably gone beyond the stage when cure is possible. A diagnosis of 'infection', as contrasted with a diagnosis of 'disease' is the key to this problem."

* Read at a meeting of the Berkshire District Medical Society.

Under such instructions it behooves us to try to understand the situation as accurately as possible, and it is in order to bring new facts to your attention that I am glad to bring certain statements before you which have been forced upon my attention in the course of recent reading.

Von Behring says, "Tuberculosis in the adult is the result of a song begun in the cradle of the infant," and Biggs¹ states, "The conviction has gradually been strengthened that the first infections from tuberculosis occur during infancy and childhood, and extreme care is required if this is to be avoided in tuberculous families."

It is important for us to do away with the old idea that tuberculosis is inherited, for the experience of pathologists seems to prove that tubercular lesions are extremely rare in the new born. It is no wonder that C. J. Grulee² considers a congenital case so unusual as to be worthy of reporting. Tuberculosis is also rare during the first weeks of life, but gradually increases. It is during childhood that the greatest amount of tuberculosis is contracted, however, and people interested in human tuberculosis cannot help being interested in the experiments³ with cattle at Woodcrest, reported by Harlow Brooks, which show that tubercular cows and bulls can be safely used for breeding, providing the offspring are removed from their infected progenitors and the calves taken away from them directly after birth. In this way many valuable cows which are tubercular may be safely used to perpetuate desirable traits, and great loss, the result of their slaughtering, is obviated. The offspring, however, should be very strictly quar-

antined. This reasoning can be applied to children, for if calves can be saved from infection, it is possible to protect the children of infected parents. Accumulated evidence shows that childhood infection is only the beginning of an adult tuberculosis, and if the children are protected, adult tuberculosis will diminish. This theory rests upon the supposition of a latent tubercle, a view which has lain dormant since it was advocated by Weigert, Harbitz and Patruschky, who wrote upon this subject ten years or more ago, stating that all cases of pulmonary tuberculosis occurring in adult life represent infections in the household in early life.

In order to understand much of the recent progress in our knowledge of tuberculosis the importance of von Pirquet's reaction must be realized. It has changed many of the old ideas and been the basis of many investigations which now flood medical literature; and in order that the physicians of the Commonwealth might better understand the practical application of this reaction, the Trustees informed us a year ago that they wished the profession to know of its practical workings, and offered opportunity at convenient places throughout Massachusetts where the profession might be instructed. The use of the test has modified our views of tuberculosis in childhood. It determines the infection of the patient. Although the infection is suspected, it is definitely proved by the test. It is the appeal of the State Board of Health that the children be protected even against infection, but when infected and proven so by the test, that they be protected against the actual development of the disease. The von Pirquet or tuberculin test is more delicate than a macroscopical examination of the body after death, for it proves an infection even when there are no gross lesions. It tells us when people are infected, although they may appear perfectly healthy and may be passed as healthy by the most searching physical examination. On the other hand, the presence of the test occurs in all stages of the disease. It may be present with a mild infection, with a small area of localized tuberculosis, with an acute general military tuberculosis, or it may be present in the final stages of chronic tuberculosis. The only thing that a positive von Pirquet reaction proves is that there is an infection with tubercle bacilli. On the other hand, when the test is positive, it is not necessary to be pessimistic, for it does not necessarily mean disease.

There is one thing which studies with the von Pirquet reaction have drawn to our attention, namely, that the great mass of tubercular people are infected in the family. Family infection plays a great part in the spread of the disease. A large proportion of infections in individuals are present as the result of infection from one individual to another, and this usually occurs from the old to the young. Infection beginning in adult life is not nearly so

much to be dreaded as infection in the infant, and when we accept this we shall come much nearer to the solution of the anti-tuberculosis problem. When there is an adult with tuberculosis the children of the family should be carefully examined. McCorison⁴ emphasized the rôle of family clusters in an address at a recent meeting of the Massachusetts Anti-tuberculosis League. Among the patients which were admitted to the North Reading Sanitarium he found 134 distinct families in which at least three cases of pulmonary tuberculosis occurred. In studying the records of one-tenth of the admissions to the Sanitarium it was proven that a group of at least three consumptives was found clustered about the one who was sent away for treatment. As the result of a study of the spread of tuberculosis in families, by Herbert Lampson⁵ of the University of Minnesota, the author concludes, first, that the spread of tuberculosis in families where open cases of tuberculosis exist is greater than it is generally understood to be. Sixty-seven per cent. of the individuals of the families investigated, excluding the center cases, showed evidence of tuberculous infection. In no case where there has been definite proven exposure of a family to an open case of tuberculosis has he failed to find a spread of the infection. In at least ten cases investigated the infection had spread to the limit of available material. Every member of these ten families showed evidence of tubercular infection. On the other hand, he concludes, "When no tuberculosis is found in a family the number of individuals showing evidence of infection is very small." Lampson's report is based largely upon the use of the von Pirquet test, and by its use other interesting results have been obtained, as those of Morris Fishberg,⁶ who reports a study of all the children of the tuberculous applying for relief at the United Hebrew Charities of New York during a three months' interval. He reports, of 692 children, 67¼% gave a positive von Pirquet; the proportion of positive reactions during the first year was 15%; two years, 55%, steadily increasing to 74½% during the period from the 11th to the 14th year.

Vedder and Johnson⁷ summarize as follows: "A study of tuberculin tests in 1321 hospital children in St. Louis shows that the percentage of positive reactions reaches a maximum of 44% at the age period of 10 to 14 years."

The experience of Pollock⁸ shows that 96% of the children in Vienna were infected before the 15th year, while Hamburger⁹ states that 95% of the children in Vienna are infected.

Calmette¹⁰ found during the first year while only 9% were infected, that the percentage kept increasing until it was over 87% at 15 years. Reports from other large European cities show similar results.

Manning¹¹ of Seattle wrote as follows: "I made a careful clinical study of 228 children

coming to the tuberculosis division of the Seattle Health Department in relation to tubercular surroundings. Of 166 children with definitely known exposure to tuberculosis, 50.6% reacted positively to the von Pirquet test; 49.3% reacted negatively to the same test. Of the 62 children examined with a history of no known exposure, 22.8% reacted positively and 77.4% reacted negatively. Between 10 and 15 years there was the largest number of reactors, 58.1%."

Hillenberg¹² studied a prosperous agricultural community in Germany where no open cases of tuberculosis had been observed for years, yet he found one-fourth of the children between 6 and 14 years showed infection.

You will notice that Manning's results, as well as Vedder and Johnson's, are lower than those of foreign observers. But it is apparent, after studying American and foreign figures, that the proportion of infections increases from year to year till it must be admitted, even in our own country, by the time children reach 15 years of age half of their number have been infected, and most of these from some individual in their own family and not from outside sources. We must frankly admit our ignorance of the number of children infected in small towns, but admit by analogy the fact that there is a gradual increase of the number affected up to 15 years of age. On the other hand, as the number of the infected increases with age, the mortality diminishes. That is to say, the older the child, the better his chances when once infected. Thus Hamburger⁹ would have us believe that while 80% of children infected before one year of age die, only 10 to 20% infected after two years die. LaPage,¹⁸ from post-mortem evidence, states that the mortality rises during the first year, reaches its maximum in the second year, and then falls rapidly.

Rogers¹⁴ says, "Before the age of two a positive skin reaction seems to be an indication that the child's life is likely to be short."

Wallstein and Bartlett,¹⁵ after careful study of 1320 autopsies at the Babies' Hospital of New York, state that of the 178 tubercular lesions found, 75% were in subjects under two years of age and only 25% in the older children."

Morse¹⁶ says a very small proportion of the children responding to the von Pirquet reaction, however, have tubercular disease. Those who are well and show no symptoms of tubercular disease are little, if any, worse off than those who have not been infected. In fact, it is probable that in many, if not most instances, they are better off in that they have established a certain immunity to tuberculosis.

Baldwin's¹⁷ ideas have a broader viewpoint than the outlook for one generation. He believes that in the ultimate survival of those who acquire a relative immunity there will be a tendency to diminish the severity of the disease.

By inherited immunity the disease will be combated and reduced in virulence, so that after many generations its severity will be reduced. He believes that the opportunity for infection will react to the benefit of the human race by establishing a gradual immunity.

Fishberg⁶ claims that by this method the Jewish race, which pays a very small toll to tuberculosis, has acquired a larger degree of immunity.

Authorities of today believe that the majority of tuberculosis begins in childhood, and the greatest hope for its extermination lies in the prevention of infection in childhood. This means that children must be guarded against infected members of the home circle and forces attention upon the sociological conditions of the child's life.

Where it can be carried out, as in tuberculosis dispensaries, careful examinations and von Pirquet tests of all children in tuberculous families must be a part of the routine practice, and when children are in the pretuberculous or tuberculous state they should have the benefit of out-of-door life, general hygienic or sanitarium treatment.

Hess¹⁸ would have New York erect preventoria, where the children of tubercular parents could be kept free from the poison of the home life. Yearly physical examinations of all public school children are now customary, and one of the great results is the early discovery of the tubercular or pretubercular state. The principal difficulty is that with our present equipment the diagnosis may be made quite early, but we have not the machinery for treatment. The proper management of such cases at home, when sociological conditions are unfavorable, is indeed difficult and the tendency is to erect institutions to meet the conditions. Open-air schools, sanatoria and preventoria at present seem to be on the increase as a partial solution to the problem, and it is interesting to note that in New York there is a so-called Home Hospital, where a family in which a case of tuberculosis exists is moved to live under bettered conditions, in the hope of preventing the infection of the rest of the family, particularly the children.

It would be unwise to lay too much stress upon bovine tuberculosis when we are just beginning to comprehend the disease in human beings, but we cannot discuss the occurrence of tuberculosis in infancy and childhood without acknowledging a relationship between the two. While the great proportion of infection results from exposure to human cases, we must acknowledge that a certain number of cases originate from tuberculous cattle. It is hoped, however, that any attention drawn to this source of infection will not divert attention from the much larger and more important subject of human infection.

It is generally agreed that, whereas there is a certain relationship between the number of

people infected with bovine and human tuberculosis this appears to vary with age.

The greatest number infected with the bovine variety occur in infancy and childhood and do not increase with age, but this is not the case with the human type, which increasingly manifests itself in adult life.

If we concede that tuberculous infection takes place mostly in childhood, bovine infection assumes a new importance, and the warning of the Massachusetts Board of Health that milk from tuberculous cows is extremely dangerous for young children deserves greater attention.

The Massachusetts Board of Health says in its circular to our profession, "Furthermore, remember that milk from the cows is extremely dangerous for young children, and urge your patients to pasteurize their milk."

Many of us will have a prejudice against pasteurizing milk unless we know it is necessary. But a review of the literature on the presence of tuberculosis in cattle will convince anybody that the danger is a real one.

The United States Bureau of Animal Industry estimates that at least 20 to 30% of the dairy cows in our country are affected with tuberculosis, and I imagine these figures are not far out of the way for our own region.

The results of individual investigators, as well as the British Royal Commission on Tuberculosis and of the German Commission, show that, whereas pulmonary tuberculosis is practically always human in type, there is a considerable percentage of bone, joint, abdominal and lymph gland tuberculosis which is bovine in origin. Park and Krumweide¹⁹ of the New York Board of Health, after collating the results of foreign and American investigation, declare a very high percentage of abdominal tuberculosis and cervical lymphadenitis is due to the bovine bacillus. The percentage of children infected varies according to different observers, but Orth says 10% of all tuberculosis in children is due to bovine infection.

An English observer²⁰ says "not less than 25% of the tuberculous children under five years of age suffer from an infection of bovine origin," while Rosenau²¹ states "one-fifth to one-fourth of all cases of tuberculosis in infants and children are associated with the bovine bacillus."

In Park and Krumweide's series of 1511 cases of human and bovine infection, 12.5% of the fatal cases under five years were bovine. The cases show a high percentage of abdominal tuberculosis and tubercular cervical lymphadenitis due to the bovine bacillus.

The occurrence of the bovine type has been most easily and advantageously studied in infected cervical glands.

Mitchell²² of Edinburgh, after studying 72 such cases, found 65 cases yielding bovine and only 7 yielding the human type. Eighty-eight per cent. of the children 2 years and under had

been fed on unsterilized cow's milk. Fraser, in the same city, in 100 cases of bone tuberculosis found 62% bovine and 35% human, while 3% yielded both types.

Melcher²³ studied the method of infection in 80 consecutive cases of tubercular cervical lymphadenitis, and found 88% bovine in origin, 12% human in origin. All of these children were under 12 years of age and 84% of those under 2 years of age had been fed on raw cow's milk. He concludes that the infection came from the cow's milk.

A. Stanley Griffith,²⁴ in a study of cervical gland tuberculosis, showed that the proportion of bovine infections was greatest in children under five years of age, namely, that 90% of such infections occurred under that age.

A. Philip Mitchell,²⁵ having previously studied the frequency of bovine tuberculosis in glandular tuberculosis in the children of Edinburgh, reported that on the bacteriological examination of 406 samples of milk collected from as many shops there were 82, or 20%, found to contain the tubercle bacilli.

In the present state of our knowledge, we are apt to think of two distinct types of tubercular germs, and yet that they have a certain relationship cannot be doubted. Their actions are similar and their biochemistry is certainly very similar. The two varieties have been found in the same individual. Tuberculin made from the two varieties seems much the same. It is perfectly comprehensible, and in fact a matter of every-day experience, that tuberculin cures certain cases of tuberculosis in human beings which are caused by the human type of germ. It seems equally comprehensible that a bovine tuberculin may cure lesions in man or beast caused by the bovine type. In both these lines experience will teach many practical points, and we shall all be interested as progress is reported. The value of the tuberculin of one variety in its action upon the lesions of another is only suggested by recent literature. At the Tenth Annual Meeting of the National Association for the Study and Prevention of Tuberculosis, Dr. Gililand²⁶ reported that he had treated cows with a vaccine prepared from human tubercle. (The work was conducted at the Experimental Farm of the Pennsylvania State Live Stock Sanitary Board.) The injections were given at varying intervals and in varying amounts. The vaccinated cows were exposed to infection by close association with badly diseased cows. When vaccination had been properly done the cows were apparently rendered immune but the unvaccinated cows died or developed large lesions. Dr. Gililand particularly calls to our attention the fact that it was the injection of the human type of germ which gave immunity to this group of cows, and believes that the experiments suggest a hopeful outlook, but does not prescribe any practical method of immuniz-

ing cows which can be advocated for ordinary use.

W. L. Moss of Baltimore²⁷ attempted to immunize calves against tuberculosis. Six calves of approximately the same age, weight and breed were selected from healthy, non-vaccinated cows. Three of these calves were fed from birth with the fresh mixed milk of several vaccinated cows. The three remaining calves were fed during the same period with an equal amount of fresh mixed milk from non-vaccinated cows, proved by the tuberculin test to be free from tuberculosis. At the end of several months all six calves were inoculated with a medium dose of bovine tubercle bacilli. The feeding of all calves was continued as previously until the termination of the experiment. At the conclusion of the experiment a necropsy was performed on one calf from each group and the lesions present compared. The calf which had received milk from immunized cows showed a small lesion at the site of inoculation, about 2 cm. in diameter, containing caseous material and surrounded by a thick fibrous wall. The related axillary lymph glands showed small caseous nodules and there were a few caseous areas in the bronchial lymph glands. The control animal showed at the site of inoculation a caseous abscess, 6 to 8 cm. in diameter, with a thin wall. The related axillary lymph glands were enlarged and caseous, as were also the bronchial lymph glands and those in the region of the gall-bladder. The liver contained from 15 to 20 caseous areas 1 to 5 cm. in diameter. The result of the experiment seems to justify the conclusion that a relative degree of immunity against tuberculosis may be conferred on calves by feeding the milk of vaccinated cows.

Clive Riviere²⁸ raises an interesting point. Assuming that the bovine type is less virulent than the human, he questions whether it is not doing useful work in protecting against the more virulent human type. He doubts whether we should not take measures to secure a mild bovine infection in the way of establishing a gradual immunity rather than leave our children to risk a first encounter with the infinitely more virulent human organism.

L. Sivori²⁹ reports that experiments on immunized cows show that antigens and antibodies are found in the milk, though not in such quantities as in the blood, and, furthermore, that animals born of non-immunized mothers show antitoxins and agglutinins in their serum, thus proving absorption of such bodies through the gastro-intestinal canal. He would have us believe that the protective substances in milk immunize against tuberculosis.

Julius Rosenberg³⁰ believes so thoroughly in the value of immunized milk that he glorifies its use, and feels so confident of its usefulness that he has supplied it free of charge to a number of physicians and hospitals. Some institutions have been supplied with the milk for five

months, and at the time of his writing he had 60 cases to report in which there was positive proof of the value of immunized milk as a remedy in tuberculosis of every type and degree.

If cows immunized against the bovine variety of germ can furnish an antitoxin in the milk which is at all efficacious against the human variety, another link in the chain which unites the two organisms is established. This is only one of the relationships which are being discovered under the searching eye of modern scientific methods.

After having drawn your attention to the prevalence of bovine tuberculosis let us approach it from the standpoint of research by Briscoe and McNeal,³¹ based on studies of the herds of the Illinois Agricultural Experiment Station. They conclude:

"The results indicate that well-nourished cows which react to the tuberculin test but otherwise appear normal do not commonly pass tubercle bacilli in their milk. Furthermore, under good conditions of dairy management tubercle bacilli are not likely to be found in the milk of such cows when it leaves the dairy. A certain number of such animals, however, in spite of their healthy appearance, are passing virulent tubercle bacilli from their bodies and are, therefore, a constant menace to everything in their environment. So far as we know there is no practical means of distinguishing between these dangerously tuberculous cattle and those which merely react to the tuberculin test, but are not excreting the bacilli."

There appear to be two ways to avoid the use of milk containing tubercle bacilli. The first is the best in theory but impossible in practice. It would seem a very proper procedure to kill all animals that are proven tubercular by the tuberculin reaction, but from the standpoint of the farmer as well as from an economic viewpoint this is impossible of execution. The popular voice would never tolerate the destruction of capital necessary to such wholesale slaughter. The voice of science would also say that the tuberculin reaction is too uncertain to be a rational guide in such a procedure. Nobody in the present state of our knowledge would venture to diagnosticate all the cows infected or all the cows diseased, and for a long time makeshifts must be adopted.

The tuberculin test is of use in certain private herds and selected dairies, and some people demand a certified milk from such dairies. This is only one step which shows that the people are gradually being educated to the desirability of a clean milk, but it does not prove that it can ever be carried out on a wholesale scale. Doing away with all the tubercular cows seems an utter impossibility, and we can never hope to see the day when the milk of tubercular cows is not offered to the public.

A more practical method is offered in pasteurization. The Massachusetts Board of

Health urges that this be commonly adopted, and in many of our dairies it is already in practical use. It is not an expensive method and it does away with many dangerous germs besides the tubercle bacilli. It is a good hygienic measure, which demands its general acceptance by the farmers as well as the endorsement of the medical profession.

SUMMARY.

1. A positive von Pirquet reaction is a proof of tubercular infection.
2. Tuberculosis in the adult is the result of a song begun in the cradle.
3. Tuberculosis is largely contracted in the home circle.
4. The number of children infected increases with the years of age.
5. A von Pirquet reaction during the first two years of life signifies a bad prognosis, but the mortality decreases as the years advance.
6. Infection with small doses of the germs at infrequent intervals may gradually establish immunity.
7. Infection with the bovine type of tuberculosis occurs mostly in infancy and childhood, while the human type is chiefly manifested in adult life.
8. The bovine type manifests itself chiefly in disease of the bones and lymph glands of the neck and mesentery.
9. There is a possibility that the milk of immunized cows may be useful in the prevention and treatment of tuberculosis in the human.
10. Pasteurization of milk should be generally adopted.

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Original Articles.

FRACTURES OF THE LOWER END OF THE HUMERUS.

By W. E. LADD, M.D., F.A.C.S., Boston.

FRACTURES of the lower end of the humerus occur with much greater frequency in young patients than in adults. The treatment of these cases at the Children's Hospital has for some years past been fairly uniform. The majority of such cases have been put up in the position of acute flexion termed by Ashurst "hyperflexion." In general, reduction has been accomplished by manipulation only. In a small number, open operation has been resorted to, or a special variation in the position of immobilization, as indicated by the direction of the displacement of the fragments. For restoration of function, massage and passive motion have not been employed, but active motion has been relied upon entirely.

Upon such a general outline of treatment it has been interesting to compare the results secured here with those reported by other surgeons. For this purpose the routine records of the hospital have been studied, and in forty-five cases in which the records were complete and the skiagrams satisfactory, end-results have been secured.

For general consideration these cases have been broadly grouped as fractures of the internal condyle, fractures of the external condyle, and supracondylar fractures. Fractures which pass directly across the two condyles, termed diacondylar by many surgeons, have been classed with the supracondylar fractures. The principles of treatment in the two groups do not vary, nor is this fine anatomical distinction necessary for the interpretation of end-results.

In order to compare the end-results, standard terms of recovery must be adopted. A perfect result, as defined by Ashurst, Neuhof and Wolf, and others, is one in which the full range of motion is preserved and the carrying angle is normal.

An analysis of the work of a few representative surgeons seems more adequate for representing differing surgical points of view than a generalized summary of the entire subject.

The recent work of Neuhof and Wolf, advocating the value of early mobilization and massage, has been carefully gone over with reference to the type of fracture, the method of reduction, and the period of immobilization, as well as the after treatment recommended. The methods they advise are not in accord with either experience or practice here. Within my own observation, cases have occurred in which the size of the callus had been increased and the amount of motion limited by early passive motion and massage.

The practical difficulty to parent and child in