PRIMARY TUBERCULOSIS IN CHILDHOOD*

BY

WILFRID F. GAISFORD, M.D., F.R.C.P.

Consulting Paediatrician to the Warwickshire County Council Hospitals

The problem of tuberculosis in infancy and childhood—especially in infancy—is still far from being solved. The British Paediatric Association published a report (1943) on "The Early Diagnosis of Intrathoracic Tuberculosis in Childhood," and this report gave rise to considerable criticism on the part of the various tuberculosis organizations. Arising out of this a joint meeting of the Tuberculosis Association and the British Paediatric Association was held, and, in spite of the friendly spirit evident, it was clear that each party viewed the problem in an entirely different light. The Tuberculosis Association members quoted figures from their official returns, both of morbidity and of mortality, which were totally at variance with the clinical experience of the paediatricians, and in the main their conclusion was that "childhood tuberculosis is not of great importance to the public health services," and their plea was for the paediatricians to preserve a sense of proportion!

Now, there must be some explanation for this divergence of views about both the incidence and the importance of the condition. Are paediatricians wrong in stressing the matter as they do? Are they making too much fuss about something of less importance to the community than adult phthisis? I do not think so. Anyone working among children, and particularly in children's hospitals, and seeing the scores of infants dying of tuberculous meningitis must realize the gravity of the situation, considering that the majority of such infants die within three months of their initial infection and that every year thousands of infants and children are infected by phthisical adults. Although the majority pass through their primary infection and are none the worse for it, and although only a very small proportion progress to tuberculous meningitis, yet there is much pain and illness due to bone, joint, and kidney disease following a primary infection, as the records of any children's hospital will show.

It is interesting that the American public health administrators take a view similar to that of our tuberculosis authorities. Plunkett (1939) estimates that it costs 40 times as much to find a case of childhood tuberculosis as it does an adult case, and he therefore recommends investigating only children from known tuberculous households—which is what obtains generally in this country. Nelson (1942) says, further: "One must recognize the necessity of being selective in the expenditure of the efforts of public health agencies and the need for directing activities into the channels which will be productive of the greatest good to the general population."

Why is there this divergence of views? I think the tuberculosis officers do not get a fair view of the picture as paediatricians see it. Many cases are missed: many more are never seen by the tuberculosis officer; they are sent direct into hospital or to the out-patient department, and there their notification is either intentionally or inadvertently overlooked. Few convalescent homes will admit cases of tuberculosis even though they are certified as non-infective, as most of them are, and prolonged convalescence is an integral part of their treatment and it is unwise for them to go to sanatoria, where there is a risk of their coming into further contact with open tuberculosis. Furthermore, from a practical point of view, it would be impossible for tuberculosis officers, under existing conditions, to deal with all the cases, even if there were adequate accommodation.

Diagnosis

Primary tuberculosis is important because it is the commonest manifestation, because it is often difficult to diagnose, because it most easily leads to the tracing of the adult infector, and because when adequately treated it gives excellent results. As is well known, it is usually intrathoracic and due to direct droplet infection or, in the case of crawling infants, to infected dried dust from the floors or carpets of a house where a phthisical adult lives.

The ordinary symptoms of adult tuberculosis—cough, fever, night sweats, loss of weight, sputum and haemoptysis—are not common symptoms in primary tuberculosis in infants or children.

Cough.—Excluding children ill with bronchitis, pneumonia, and whooping-cough (and remembering that many children with primary tuberculosis are not ill when first seen) the commonest cause of cough in childhood is upper respiratory infection—especially tonsillar.

Fever.—The commonest causes are upper respiratory infection (including otitis) and pyelitis, both especially common in infancy. There is an "initial fever of infection" in primary tuberculosis which lasts for a week or ten days and is usually overlooked or considered influenzoid in nature. It is seldom of diagnostic value.

Night Sweats.—These are rare in children: they do not occur in primary tuberculosis. In infancy, rickets, digestive disorders, pyelitis, and pink disease may be causative.

Loss of Weight.—This occurs in many nutritional disorders in infancy and is of no real help in arriving at a diagnosis of primary tuberculosis.

Sputum.—Children rarely expectorate, except occasionally in bronchiectasis, and *haemoptysis* is even rarer. Neither of these is a symptom of primary tuberculosis.

In fact, the condition is often subclinical throughout, and there are no characteristic physical signs which can be considered pathognomonic.

Erythema nodosum and phlyctenular conjunctivitis are two commonly encountered conditions in paediatrics, and they are both very suggestive of primary tuberculosis. The younger the child the more likely are they to be tuberculous. They are not in themselves tuberculous, but are manifestations of tuberculin allergy. Erythema nodosum may occur in rheumatism, cerebrospinal fever, and as a sign of sensitivity to sulphathiazole; but by far the largest number of cases occur in primary tuberculosis, and it has been called "the exanthem of tuberculosis." It usually marks the onset of allergy at the end of the incubation period.

X rays are of value in the diagnosis of primary tuberculosis, especially serial films, as there are few other causes of persisting abnormal lung shadows in childhood.

The *tuberculin test* is the only sure diagnostic test. It is impossible to diagnose primary tuberculosis with certainty without its use (except by actually finding tubercle bacilli—as, for example, in stomach washings). Often it is the only positive finding at the time of examination, and further confirmation may not be forthcoming for months till skiagrams reveal a parenchymal or glandular lesion.

As a routine a preliminary percutaneous test (jelly, ointment, or plaster) may be used, but if this is negative a Mantoux test must follow before tuberculosis can be definitely excluded. The technique of intradermal injection is so easily acquired, however, and, properly performed, so little upsetting to children, that the Mantoux test still remains the method of choice as a routine. For infants and children it is safe to use 0.1 c.cm. of 1 in 1,000 old tuberculin (i.e., 0.1 mg.), except in cases of erythema nodosum and phlyctenular conjunctivitis, which are generally hypersensitive and in which a 1 in 10,000 solution should be employed. If the 1 in 1,000 solution gives no reaction and there is still doubt about the possibility of tuberculosis, then a 1 in 100 solution may next be tried, and if this too is negative a 1 in 10 solution. If there is no reaction to this the child (unless moribund) is not suffering from tuberculosis. Once a child is known to be Mantoux-positive, the fact should be noted in his record in the same way as his Schick test, immunizations, etc. It has been said, "If 100% be allotted to the Mantoux test in the diagnosis of primary tuberculosis, then *x* rays earn 25% and physical examination a fraction of 1%."

Of course, finding a positive reaction does not mean that the child is necessarily suffering from tuberculosis, but it does mean that he should be further investigated—first by skiagrams: if these show any abnormality a blood sedimentation test may give some indication of activity, and gastric lavage and guinea-pig inoculation may yield confirmatory evidence.

Treatment

If the sum total of these investigations confirms the diagnosis of primary tuberculosis, what is to be done with the child? The most important thing is rest in bed until the blood sedi-

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mentation rate is normal and skiagrams show evidence of healing or the lesion appears quiescent; then fresh air, good food, adequate amounts of vitamins A, C, and D, and not too much fat and "malt and oil," which are often given to the detriment of the appetite.

There is abundant evidence that repeated exposure during the initial period after infection tends towards severe disease and liability to miliary spread. Therefore children, and especially babies, should be carefully watched for three months until the likelihood of meningitis is passed, and should be separated from any known contact. If a home contact must persist—e.g., the parent cannot go to a sanatorium—then the infant should be sent to a preventorium, where special care should be taken to avoid exposure to, or have immunization against, epidemics such as measles and whooping-cough.

There is, again, ample evidence that breaking the contact materially lessens the mortality and morbidity. Children with erythema nodosum need careful watching—being "hyper-allergic"—and should have bed rest for six weeks, after which time the chance of dissemination is less. After the period of bed rest the children should be allowed up for increasing periods daily and be permitted exercise also. School-children are preferably allowed to run wild for a term if reasonable hygienic conditions prevail at home and they can have plenty of fresh air.

Finding a positive reaction in a child—for example, by routine testing—does not involve an immediate diagnosis of active tuberculosis, a warning to the parents of possible meningitis, notification to the tuberculosis officer, and so on, but it does involve a little extra work. Park says, "There are two ways of finding out if an adult has tuberculosis: one is to find the bacilli in his sputum—the other, the infection in his infant." Under the age of 2 years over 80% of infections are intrafamilial in origin, so the parents and other members of the family (including nurses and maids, if any) should be examined and *x*-rayed. At school age the contacts are so many and varied that it is manifestly impossible to trace them all.

What is the Fate of the Primary Infection?

Either spontaneously or with treatment it may undergo fibrosis and calcification and heal completely. This is usual. Untreated, it may proceed to caseation in the primary focus, bronchogenic spread, glandular spread in the hilum, or blood-spread with resultant metastases. The site of these depends on the vessel involved and the number of bacilli entering the circulation. If a branch of the pulmonary artery be involved miliary tuberculosis results; if the pulmonary vein, either meningitis or, if only a few bacilli enter, isolated bone or kidney metastases. If the glands caseate and discharge into the thoracic duct both lung and systemic spread may occur.

Clinical Importance of the Primary Infection

A healed primary lesion does not confer complete immunity to reinfection; but partial immunity may result, with ability to withstand heavier infections or to cause greater localization of lesions. This limited immunity can be overcome by vast or virulent infection. Immunity takes some time to develop, perhaps 12 to 24 months. Wallgren says that, after immunity *is* developed, further exposure to infection is not harmful. There are two schools of thought about the importance of the primary infection—one that it is benign but that the resulting allergy is dangerous, the other that allergy is beneficial. Wallgren goes so far as to recommend vaccination with B.C.G. The relationship, if any, between allergy and immunity is not known.

Immediate Dangers of the Primary Infection

The majority of cases quiesce, but age is the important factor. The death rate is higher in the first two years of life than at any other period of childhood, because of lower resistance and greater and more repeated exposure (due to the intrafamilial nature of the infection). Wallgren (1941) found a mortality of 36.9% in the first year of life, and Price (1942), in Dublin, of 77% in 1937, reduced to 28% in 1940 after instituting routine tuberculin-testing in the newborn on the district and treating the positive reactors in preventoria. Terplan (1940), in doing 699 routine necropsies, found 35 deaths from tuberculosis, of which 30 were due to primary tuberculosis. Mitchell and Willis (1944) treated 213 children under the age of 3 for a year or more, with a 9% mortality, and Salomonsen and Traetteberg (1935) in a ten-year follow-up found a mortality of 4%. The conclusion is that, given adequate treatment for a sufficiently long period, the prognosis is excellent.

Extrathoracic Foci of Primary Infection

The alimentary tract is the chief site. Infection follows ingestion of bacilli, either human from dried dust or bovine from milk. The primary focus is in the ileum in the region of Peyer's patches, and the complex is completed by the mesenteric gland draining that area. As in other extrathoracic foci, the primary lesion is usually microscopic. The tendency is for the lesion not to localize as well as a primary *pulmonary* focus, and there is a danger of meningitis by rupture of the caseating mesenteric gland into a mesenteric vessel. Normally the gland calcifies.

I have seen one case of primary tuberculosis of the *skin* following ritual circumcision, the complex being completed by the inguinal gland. The *tonsil* is sometimes a primary site (as in the Lübeck disaster), and the cervical gland on the affected side then becomes involved.

Some Practical Points

Lastly, a few practical considerations concerning childhood tuberculosis in general (i.e., not limited to the primary form).

Watkins (1945) in Cardiff, working in a children's ward which specifically excluded cases of tuberculosis, discovered by routine Mantoux-testing that 22% of the children admitted reacted positively, and that 2.2% of these had, in fact, active tuberculosis. The presenting signs and symptoms of the intrathoracic cases were bronchitis and pneumonia, pleural effusion, wasting, erythema nodosum and phlyctenular conjunctivitis, and diarrhoea.

Capon (1937), working at Alder Hey Hospital, Liverpool, reported 56 cases of active tuberculosis among 200 children tested there (partly selected), with almost identical presenting symptoms.

What symptoms bring a child up to the out-patient department with the diagnosis "? tuberculosis," and from what is the child really suffering? I have found the commonest conditions to be: (1) cough; (2) glands in neck; (3) diarrhoea, especially if with a swollen belly; (4) limping; (5) swollen joints; (6) fever.

Cough.—This is most commonly due to upper respiratory infection. Post-pneumonic fibrosis, with or without bronchiectasis, is an occasional cause.

Glands in Neck.—Dirty heads, impetigo, and tonsillar and oral sepsis predominate. Cystic hygroma and secondary malignant glands occur rarely, but I have seen examples of both which needed differentiating from tuberculous glands.

Diarrhoea.—Rickets, Hirschsprung's disease, coeliac disease, and cystic fibrosis of the pancreas will all cause diarrhoea similar to that occurring in tabes mesenterica. The last-named is perhaps the commonest, and many of the cases labelled coeliac disease really belong to this group; they are differentiated from them by having less buttock-wasting, by having recurrent attacks of pneumonitis, and by clubbing of the fingers. Tabes mesenterica is even more to the fore in differential diagnosis, as if the lacteals become blocked in tabes—as they may from glandular pressure—the faeces become pale, foul, and fatty just as in pancreatic fibrosis.

Limping.—I think tuberculin-testing finds some of its greatest usefulness in orthopaedic cases. Lincoln has said: "The onus is on anyone making a diagnosis of tuberculosis in any child with a negative Mantoux unless the child is moribund."

Swollen Joints—or usually One Swollen Joint.—Tuberculous joints must be differentiated from rheumatism without carditis, Still's disease, and "tuberculous rheumatism." The Mantoux test is more valuable than skiagrams in joint disease, in cases of doubt. *Tuberculous rheumatism* is an allergic arthralgia rather than a true arthritis—not responding to salicylates, not having carditis, and having a positive Mantoux. It has been described chiefly in the French literature, but Sheldon (1945) recently reported a series of cases in this country.

Fever: Especially Continued Fever of Unknown Origin.—Urinalysis, a differential white blood count, and blood agglutinations will often clear up the diagnosis. A negative Mantoux with 1 in 100 will exclude tuberculosis as a cause.

Among in-patients the commonest diagnostic difficulty is probably differentiation between appendicitis and tuberculous

mesenteric glands. Here, to wait for the result of the Mantoux test is impracticable, and in cases of doubt the surgeon will always operate. If he finds a tuberculous adenitis no harm will be done, and an opportunity will be afforded for testing the potency of a new bottle of tuberculin on an undoubtedly positive case!

Conclusion

I may conclude by quoting a remark of Nelson's. He said: "One of the shortcomings of the average general practitioner is his failure to recognize the relationship of his private practice to the general health problems of the community. The ideal procedure would be for him to do tuberculin tests on all children under his care and order *x* rays on all positive reactors and their contacts." If we could get this far we should at last really be on the way to solving the problem of primary tuberculosis in childhood.

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INTELLIGENCE AND INFANT MORTALITY IN PROBLEM FAMILIES

BY

S. W. SAVAGE, M.D., D.P.H.
County Medical Officer, Herefordshire

The objects of the investigations described in this paper were: (1) To discover the number of problem mothers in an area which was predominatingly rural, with a population of 90,800. (2) To ascertain the intelligence of these problem mothers. (3) To discover the effect on the development of children living in the inefficient domestic environment made by the problem mothers and to compare them with children from normal homes (controls). This is of great interest when the intelligence of problem and control mothers is the same. (4) To examine the rate of infant deaths occurring in problem and control families.

A "problem mother" is a woman who does not give her children at least the minimum of care and refuses to co-operate with the health visitors and make effective use of the technical advice available to her. The fathers have not been included in the investigation; but it is not denied that their influence on the children is considerable (though probably less than the mothers').

The problem families were detected through the affected children. These children became known through the school medical officers, the health visitors, and the school nurses. Children were sometimes reported from other agencies such as the N.S.P.C.C. In all these cases the homes were visited and the mothers instructed by the health visitors. When the mothers persistently failed to take advantage of this teaching and continued in their inefficient domestic practices the family was recorded in the problem group. Whenever there was any doubt about recording a family in the problem group a special visit was made by the supervising health visiting staff. In the course of the survey I have personally visited most of the families. In these ways a uniform standard was preserved.

For the purposes of this survey it was necessary to make a comparison with a number of families whose domestic management was at least moderately efficient, and who lived under the same general economic standards as the problem families. These were the control families; they were selected by the health visitors. The standard of housing of both the problem and the control families was similar. There is room for improvement in some of the houses in both groups. Most of the families under review come within the Registrar-General's Social Class V. Although the whole summary took many months the records were kept completely up to date; the following tables therefore record the position on the day when the survey was completed. The preliminary ascertainments made are expressed in Table I:

TABLE I.—*Survey Area*

Population	90,800
Number of families with pre-school and elementary-school children	7,215
Number of problem families	89
Percentage of problem families	1·23
Population of pre-school and elementary-school children (7,295 + 10,168)	17,463
Number of pre-school and school children in problem families	333
Percentage of problem family children compared with all children in the area	1·9
Annual infant mortality rate for the area (1944)	38·7
Infant mortality rate for the area during the last 10 years	48·5

The total number of families was estimated from the records of pre-school and school children in a section of the area, and the number in the whole area was calculated from this information.

In my view, one of the most important observations to make in a problem mother is an assessment of her intelligence. When the mother has intelligence there is a possibility of teaching her by detailed and persistent instruction, but with an intellectually defective mother improvement is almost impossible. Intelligence can be estimated in various ways, but after an investigation of many tests the Raven progressive matrices were chosen as being most suitable for assessing intelligence in people who may have very little general education but may nevertheless be reasonably intelligent. It will be seen from the tables that the Raven test makes use of five grades. Some of the testing was carried out by specially selected health visitors and some by myself. The selected health visitors were first tested and then instructed.

Comment on Table II

The problem families (89) were classified according to the type of neglect found in the children. By far the most were in Group I, "general neglect"; there were a number of families in which the children suffered from persistent pediculosis capitis and in which the general neglect was less obvious than the pediculosis (Group II). When the general neglect was also very marked they were placed in Group III. The feeding of all these children was usually unsatisfactory, but when this was obviously bad and the children also suffered from pediculosis the families were placed in Group IV. The average age of the school-children in problem and control groups was similar (it is recorded in detail in Table III).

The educational position of all the school-children is shown. This was obtained by reports from the head teachers. The percentage of those retarded two or more years has been also calculated. Objection might be made to the use of the educational attainment as an index of intelligence, but means were not available for carrying out tests such as the Binet-Simon on the 409 school-children. It will be observed that those in the problem families were very considerably retarded. In all problem groups a proportion of the children were retarded sufficiently to bring some of them within the mentally defective classification Of the 223 children 55 (24.6%) were retarded three or four years, and if the children of only two years' retardation are also included, almost 50% of the school-children from the problem families were retarded. The corresponding figure for the control children was 9%.

This retardation was highest (65%) in the children suffering from pediculosis and an inadequate diet (Group IV), and lowest (37%) in the children who suffered only from persistent pediculosis (Group II). It is interesting to note that the only children described by the head teacher as "advanced one year" came from the group with the highest percentage of retarded children. These children have had school meals, but so have some of the other children in families known to have had an inadequate diet.

The infant mortality rate in the problem families was double the rate in the control families. In the problem families the highest infant mortality rate occurred in the "general neglect" group. The numbers in Group IV were insufficient for a reliable rate to be calculated.