

and those authors were able to show a substantial reduction in the number which developed complications. Confirmation of the efficacy of the particular drug employed was obtained from its beneficial effects in another condition caused by the haemolytic streptococcus treated in this hospital—namely, erysipelas. It is also reported by many workers that prontosil is not active towards certain strains of haemolytic streptococci. This may have some bearing upon the present findings.

In order to study the effect of larger doses the following amounts of para-benzylaminobenzenesulphonamide are being given in a further series of cases of scarlet fever: Cases under 5 years of age, 1 gramme thrice daily for seven days; then 0.5 gramme thrice daily for seven days. Cases over 5 years of age, 1 gramme four times daily for seven days; then 0.5 gramme four times daily for seven days. So far twenty-two cases have been treated, with the following results. Five cases have developed complications (rhinitis 1, adenitis 1, relapse 2, impetigo 1), and there have been two cases of toxic erythema. Although the number is small there is no reduction in the incidence of complications.

Summary

In a series of strictly controlled cases of scarlet fever during the period July, 1936, to May, 1937, the administration of para-benzylaminobenzenesulphonamide was found to have no significant effect upon the duration of the initial pyrexia, the initial toxæmia, or the incidence of complications. Various reasons for this finding are advanced. I personally incline to the belief that a combination of three factors is responsible—namely, the mildness of the disease; the fact that a haemolytic streptococcus which is not affected by the sulphonamides, or only slightly affected, was the causative organism; and that while it is less toxic the para-benzylaminobenzene-sulphonamide is also less active than its companion reduction products.

I wish to acknowledge my indebtedness to Dr. M. Mitman, superintendent of the Eastern Hospital, at whose instigation this work was started, for his kindness in allowing me to publish the findings.

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THE OCCURRENCE OF SUBCLINICAL TRICHINOSIS IN BRITAIN

RESULTS FROM 200 LONDON NECROPSIES

BY

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Recent work in America (summarized and extended by Hall and Collins, 1937) has shown that the population of the United States has a high incidence of unsuspected trichinosis, about 12 to 13 per cent. of over a thousand cadavers examined post mortem being infected with encysted trichinella larvae. In not one case had trichinosis been diagnosed during life, despite the fact that several of the cases showed an infection of up to 1,000 larvae per gramme of muscle. The aetiology of trichinosis in the United States has been discussed by Hall (1937a), who has stated that this high incidence of human trichinosis is almost certainly due to the practice of insanitary methods of pig-rearing such as garbage- and swill-feeding, trichinous pork scraps from trimming plants and table refuse being re-fed to pigs, thus maintaining a high percentage of infection among the animals. Only a small proportion of such pig meat is ever examined by Federal inspectors, and the consequent degree of exposure to infection of the population is thus dangerously high. Grain-fed swine show a very low incidence of infection, and the part which rats play in the transmission of the disease is small, trichinosis being transmitted direct from pig to pig in trichinous garbage.

Previous Records of Trichinosis in Great Britain

In spite of rigid meat inspection trichinosis still persists in Germany and Denmark, but the scarcity of records of trichinosis in Great Britain suggests that the disease is uncommon in this country. Apart from the original specimens discovered by Peacock, Hilton, and Paget and described by Owen and Farre, trichinae have been found post mortem in the following instances in Great Britain, trichinosis having been unrecognized during life. The clinical history of the Wood (1835) case in Bristol Infirmary, however, shows the typical symptoms of trichinosis—acute rheumatic pains, dyspnoea, and pericardiac inflammation—the patient finally succumbing to pneumonia. The probable cause of these symptoms was not discovered until after death, but even then the true relation of the encysted trichinae to the clinical picture was not fully realized. Two cases occurred at about the same period in the London Hospital (Curling, 1835–6); in both of these the cysts were very numerous, but the disease was unrecognized and not fatal, death being due in one case to a fractured skull and in the other to an aneurysm of the aorta. Topham (1850) describes a case occurring in medical practice in Wolverhampton, the cause of death being diphtheria. The trichina cysts were well calcified, with a mass of granular matter lying near the larvae, indicating an infection of long standing. No clinical history of trichinosis had been recorded, and the source of infection was unknown.

Bellingham (1852), in his account of a case in Dublin, says that the patient had had oppression of breathing for several years, and the post-mortem examination revealed emphysema of the lungs and pus in the pleural cavities. The superficial muscles of the chest and neck were

thickly studded with cysts, but none were found in the diaphragm. Since the cysts were "tough" the infection was probably of long standing. Dr. Jacobs is quoted in the same paper as having stated that "cysts were frequently observed in the dissecting-room." Sutherland's (1897) case in Glasgow was apparently an infection of short duration, death being due to advanced pulmonary tuberculosis. University College Hospital clinical records, 1933, contain an account of the case of a lino-porter, aged 56, who died with multiple pulmonary abscesses. Several small calcified cysts in the intercostal and axillary muscles show well in a radiograph of the chest. Eosinophils were 2 per cent. Evidently this was an old infection, but the patient had resided in India, Burma, and Malta, and had served in France from 1914 to 1918.

Cobbold (1879) states that "as many as thirty to forty instances had occurred where the parasites in question had been found post mortem," no diagnosis of trichinosis having been made during life, and he further states that "trichina has not been observed in our British-fed swine in more than one or two or possibly three instances." This author also quotes Sir Dominic Corrigan as having stated that "he had often met with trichiniasis in his practice in Dublin" and that the disease "was quite common in many parts of Ireland," but whether the disease was diagnosed or discovered post mortem is not stated, and no instances of trichinosis in Ireland have been published except that of Bellingham (1852).

Several small epidemics and isolated cases of trichinosis have been recorded from time to time in Great Britain, the disease being diagnosed correctly in all instances. Cobbold (1879) describes the first recognized epidemic, in Workington in 1871, three persons being infected by sausages and boiled pork from a home-fed pig. Jones (1889) reports an isolated case in Swinton (Yorkshire), due to eating raw home-cured ham, which, however, had been supplied from America. Harris (1909) records four cases caused by eating salted pork prepared from a privately killed pig in Devonshire. A rat killed on the farm at which the pig had been kept was found "teeming with trichinae."

Rice and Williams (1922) give an account of a serious outbreak of trichinosis involving thirteen persons at Milford Haven, caused by eating sausages prepared from pigs bought and slaughtered locally; no evidence of trichinosis could, however, be found in pigs from the seven farms supplying the infected animals, nor were rats round the farms infected. Hardy, and Paul (1927) describe two cases in Smethwick due to eating roast pork from a pig supplied by a Worcestershire farm. No trichinosis could be traced among the other pigs, nor did rats on the farm show trichinae; in addition the swine were grain-fed, and no trichinae were found in over a thousand carcasses examined subsequently. Herzberg and Vitenson (1930) report an isolated case in London, acquired by eating raw bacon from an untraced source. Hickling (1931) also describes an isolated case in London, the source of infection not being stated; the patient, however, had never been abroad.

The above constitutes all the published records of trichinosis in the British Isles which it has been possible to trace; but in view of the atypical syndrome apparently associated with many cases and the difficulties still attendant upon diagnosis (Hall, 1937), it is not surprising that the disease is recognized during life only in epidemic proportions or in those few cases showing the classical symptoms of muscular pains, oedema, and marked eosinophilia. While trichinosis is in itself rarely fatal, its

incidence is nevertheless an indication of the general hygiene of the population and the efficiency of the public health precautions; moreover, mild trichinosis may predispose towards other more serious complications.

Since trichinosis may be acquired by persons who never show any symptoms of the disease, it is obvious that the incidence indicated by diagnosis during life is no criterion of the frequency or degree of exposure to infection. A study of the frequency of subclinical infections is therefore necessary to estimate the true risk of infection, and pending improved diagnostic methods such a study can only be carried out post mortem.

Materials and Methods

The incidence of trichinosis in London was estimated by digestion of diaphragms from cadavers and examination of the sediment of the digest for larvae. Diaphragms were generously supplied by four hospitals, these being Guy's Hospital and the London Hospital, covering a large part of the east and south-east of London, and a typical low economic-social population; and University College Hospital and the Middlesex Hospital, covering central, western, northern, and outlying northerly districts of London, with a larger proportion of persons of higher economic-social status.

Diaphragms were minced, and weighed amounts, usually 100 grammes, or the whole diaphragm if less than 100 grammes in weight, digested in 1,000 c.cm. of artificial gastric juice (0.5 per cent. HCl and 1 per cent. granular pepsin) at 37° C. for twenty-four hours, the mixture being constantly stirred. The digests were then poured into funnels fitted with 20-mesh brass wire screens. After one hour the sediment was drawn off from the base of the funnel, centrifuged, and examined for larvae. In addition small portions of diaphragm from near the tendinous insertions were compressed between thick glass plates and examined under the microscope for encysted larvae, since, as Hall and Collins (1937) have shown, larvae which have died previously in the cysts are not present in the sediment after digestion.

Even when determined by these two methods the incidence of trichinosis is probably still too low and the actual degree of infection underestimated, because in a few positive cases the diaphragm may be uninfected (*vide* Bellingham, 1852) and the amounts used may be too small to give a true result in larvae per gramme (Hall and Collins, 1937). Two hundred diaphragms were examined from all age groups, from stillbirths to old age, covering a fairly representative selection of population classes and districts in and round London.

Observations

Only two out of the 200 diaphragms examined (one case in each 100) showed infection with trichinella, giving an indicated incidence of 1 per cent. In both cases the infection was slight—one larva per gramme of muscle. Case 1 was that of a woman, aged 39, of King's Langley, Herts, who died in University College Hospital of post-carcinoid carcinoma. Case 2 occurred in a Hampstead woman, aged 58, who died in Middlesex Hospital from gastric carcinoma. In neither instance had there ever been any symptoms suggestive of trichinosis, and in Case 2 a blood examination showed a normal proportion of eosinophils (2 per cent.). Neither patient had ever been abroad, indicating that the infections were endemic. In each case microscopical examination of parts of the diaphragm was negative; this is in accordance with the

previous findings that microscopical examination will almost invariably miss light infestations.

Three complete cysts were recovered from Case 1 and twenty-five from Case 2; these had been perforated by the digestive juice, but the larvae were dead inside. Examination of these cysts showed that the infections were of long standing, the walls being thick, although any calcification had been dissolved by the gastric juice. Cysts from Case 2 showed a granular mass lying near the larvae, such as has been described in cysts from a polar bear and by Topham (1850) in man; these are probably masses of excretory material (van Someren, 1937). The remainder of the larvae in each case were free and active.

Discussion

These results show that in the districts and population classes examined in and around London trichinosis is an uncommon disease, and the risk of infection apparently very slight; they also suggest, however, that endemic reservoir hosts do occur, forming a potential source of danger, since one infected pig is capable of transmitting the infection to many people. An explanation of this scarcity of trichinosis may be found in the fact that, generally speaking, the British, even of the lower economic-social classes, have a relatively high standard of hygiene as regards cooking, meat being well cooked in the majority of homes. On the other hand, it is possible that encysted larvae may withstand temperatures sufficient to cook meat thoroughly, especially in the centre of a joint, where the temperature never reaches the oven temperature. The Smethwick epidemic was traced to a joint of pork which weighed 9 lb. and was roasted for four hours, a time usually considered sufficient to kill trichinae. These facts suggest that the reservoir hosts, if they do occur, are themselves uncommon, the great majority of the population never being exposed in any way to risk of infection from such sources.

The system of pig-rearing in Great Britain is such that swine have little chance of becoming infected with trichinella. As a rule gilts intended for breeding and pregnant sows run out at pasture. They may farrow in field shelters, or, as in winter, be brought indoors to farrow. Where possible the piglings and sow are allowed to run out at pasture a few weeks after farrowing. Litters are weaned at 8 to 10 weeks old, after which those intended for pork or bacon are fed indoors and sold fat at 5 to 7 months old. There is very little swill- or garbage-feeding except around towns or at or near public institutions, and the law requires that all swill must be boiled before use. (The Foot-and-Mouth Disease (Boiling of Animal Foodstuffs) Order of 1932 states that "boiled" means "exposed for a period of at least an hour by any process to a temperature of not less than 212° F.") Furthermore, swill-feeding is considered unsuitable for bacon production. Where swine are reared on proprietary foodstuffs the Ministry of Agriculture must be satisfied that the process of manufacture or preparation of such foodstuffs includes the boiling of it. It will be obvious from these facts that swine in this country have little chance of acting as infective bearers of trichinosis to the extent probable in America, being mainly pasture-fed; nor can the disease be perpetuated in swine by the feeding of infective trichinous garbage.

Local sanitary authorities deal strictly with sanitation in and around farms, and rats can play little part in the perpetuation of trichinosis; by the Rats and Mice (Destruction) Act, 1919, all lands and premises are required to be kept free from rat and mice infestations. To

assist in preventing these infestations the Ministry of Agriculture recommends that all places likely to be breeding-grounds, such as pig-sties, should be specially dealt with; action in this matter depends of course on the individual occupiers, but the general standard of hygiene and a natural dislike of such infestations ensure that these precautions are carried out satisfactorily wherever necessary, particularly during the national rat week.

It remains to consider whether imported meats constitute a source of possible infection. Of the total pig-meat supply 51 per cent. is imported (1936 figures, under revision), this being fresh pork from the Irish Free State; chilled or frozen pork from New Zealand, Australia, Argentina, U.S.A., and other countries; and salted pork from the Irish Free State, Brazil, Argentina, and other countries (in order of importance). The chief countries exporting bacon are Denmark, Canada, the Netherlands, the Irish Free State, and Poland; and of hams, U.S.A. and Canada. Thus pig-meat is obtained from countries where trichinosis is still not uncommon, but under the Public Health (Imported Food) Regulations, 1925 (Amended 1933), all imported meat is subject to examination at the port of entry and to seizure and condemnation if found to be unfit for human consumption. The importation of certain classes of meat is prohibited unless these are accompanied by an official certificate of the country of origin which has been recognized by the Ministry of Health as affording satisfactory evidence that the meat has been derived from an animal free from disease at the time of slaughter, and that it has been prepared and packed with all necessary precautions for the prevention of danger to public health. Certain classes of meat, however, including bacon, are at present admitted without an official certificate. This has been amended by the Public Health (Imported Food) Regulations, 1937, which do not come into operation until January 1, 1938, and which will prevent the importation of any meat or meat product unless accompanied by an official certificate.

In view of the special precautions laid down regarding the inspection of imported meat on slaughter it is the practice to inspect only a proportion of such meat at the port of entry. Carcasses are examined by incision, palpation, and visual inspection, but no microscopical examinations are made. It would seem, therefore, that a small channel of entry has been left for the introduction of trichinosis into this country by permitting the importation of bacon without an official certificate, particularly since such bacon may come from countries where trichinosis is more common, and also by lack of microscopical examination. Microscopical inspection is carried out in certain of these exporting countries, such as Denmark and the Netherlands, but the regulations at present may permit importation of uninspected bacon. The new regulations will be more stringent, and may decrease even the slight incidence already recorded.

These data concerning meat importation and pig-rearing probably account largely for the relative rarity of the disease in this country, but in view of the fact that sources of infection must occur and that microscopical examination may even lead to a sense of false security, the relatively high standard of hygiene of the British as regards cooking and eating probably still remains the best defence against infection.

Summary

Previous records of trichinosis, discovered post mortem or diagnosed during life, in Great Britain have been

summarized and extended by a survey of the incidence of trichinosis in 200 necropsies at four hospitals in London, covering a representative selection of districts and population classes in and around London.

The scarcity of previous records and the present findings of an incidence of 1 per cent. indicate that trichinosis is uncommon in Great Britain. Both cases found in the present survey had light infections, but the infection was endemic.

The system of pig-rearing in this country is such that swine can have little chance of acting as infective bearers of trichinosis, but imported bacon may form a slight source of infection.

The general level of hygiene and habits of the British peoples probably plays the principal part in reducing risk of infection.

In conclusion it is a pleasure to thank Professor G. P. Wright and the staff of Guy's Hospital pathology department; Professor H. M. Turnbull and the staff of the pathology department of the London Hospital; Professor J. McIntosh and the staff of the Bernhard Baron Institute of Pathology, Middlesex Hospital; and Dr. G. R. Cameron and the staff of the pathology department of University College Hospital, for generous assistance and co-operation in providing material from necropsies carried out at these hospitals. Mr. W. McDonald of the helminthology department of the London School of Hygiene and Tropical Medicine kindly made a number of the examinations in my absence, and Mr. Nicholson, laboratory assistant in the same department, gave valuable assistance in the routine work connected with these examinations.

The Ministry of Agriculture and Fisheries and the Ministry of Health generously supplied information concerning the system of pig-rearing and meat inspection in this country. I have also to thank the Imperial Bureau of Agricultural Parasitology for tracing most of the published records of trichinosis in Great Britain.

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G. F. Göthlin (*Acta paediatr.*, Stockh., October, 1937, p. 71) gives an account of the employment of the capillary fragility test for judging the effectiveness of the supply of vitamin C in adults and in children. It was found that in certain parts of Sweden there were school children who, although not ill, exhibited during the late winter and the spring a fragility of their cutaneous capillaries due to a deficiency of this vitamin in their diet. These children had a normal capillary resistance in the summer. This test is of value when there are no resources for estimating the amount of ascorbic acid in the blood, but can only be applied to fairly healthy persons. If the findings of a first test are doubtful ascorbic acid is given for a week and the test repeated. A detailed account of how to apply the test is given.

PREVALENCE OF MIDDLE-EAR DISEASE IN ELEMENTARY SCHOOL CHILDREN

OTOSCOPY AS AN ADJUNCT TO ROUTINE MEDICAL INSPECTION*

BY

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In this investigation an attempt has been made to assess the prevalence of middle-ear disease in elementary school children seen at routine medical inspections.

The Chief Medical Officer to the Board of Education referred in his report for the year 1934 to a particular symptom of middle-ear disease, otorrhoea, and explained that the ordinary methods of routine medical inspection give an understated assessment of its prevalence useful only for comparative purposes from year to year. A section of this report may be quoted here:

"An ear may have no discharge for a long period, and be apparently cured, yet as the result of slight nasopharyngeal infection—for example, a common cold—or often from no ascertainable cause, the ear may begin to discharge again. The system of routine medical inspection therefore only detects those cases that have active otorrhoea at the time of examination, and since as a rule it does not include a detailed examination of the ear, even some of the active but slight cases may be missed. Were an examination of the ears by an electric auriscope included in routine medical inspection there is no doubt that more cases of slight otorrhoea and potential otorrhoea would be discovered. The practicability of amplifying routine medical inspection in this way should receive consideration by school medical officers."

The Incidence of Otitis Media

This opinion is supported by evidence supplied by Dr. W. A. Bullough, school medical officer for Essex, whose report for 1934 contained an account of an investigation by Dr. A. Elliott in which 2,074 Dagenham elementary school children were subjected at routine medical inspection to otoscopy and special inquiry made in each case regarding any history of ear discharges. This procedure resulted in finding an incidence of 4.82 per cent. cases of chronic otitis media, while of these only 31 per cent. (that is, 1.49 per cent. of the 2,074) were continuous, 69 per cent. (3.33 per cent. of the 2,074) being intermittent and therefore liable to have been missed by the ordinary routine methods. It is presumed that all the cases so detected may be considered as "requiring treatment," but the author does not record cases of non-suppurative otitis media (such as chronic catarrhal otitis with an intact drum) requiring treatment—which latter are presumably included in the Board of Education figures given below—nor is the age distribution of the children given, though as the investigation was commenced in April, 1934, and completed before the end of the same year it appears unlikely that all age groups are included. The figures therefore are not strictly comparable to those issued by the Board, which for cases of otitis media requiring treatment *per thousand* children seen at routine medical inspection are as follows:

1929	1930	1931	1932	1933	1934	1935
5.3	5.4	5.1	5.1	4.7	4.6	4.1

Thus in 1934 the figure given by the Essex investigation for only otitis associated with active or potential otorrhoea was over ten times as great as that for all forms of otitis media requiring treatment found at inspections throughout the country as a whole; and although, as the

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