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Outbreak of trichinosis near Paris

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Summary and conclusions

A localised outbreak of trichinosis occurred in January 1976 in the southern suburbs of Paris. A total of 125 cases was recorded including 30 children. The prominent symptoms were oedema of the face or eyelids, fever, and myalgia; diarrhoea was unusual and constipation common. An increased blood eosinophil count and raised serum concentrations of muscular enzymes strongly indicated trichinosis. This diagnosis was confirmed later immunologically. The parasite was found in only three out of 32 muscle biopsy specimens but this investigation was made relatively early in the disease. No deaths occurred. In all cases clinical recovery was fast and serum antibody titres were maximum during the first month and decreased slowly. The disease was milder and the recovery faster in children than adults.

Epidemiological study suggested that horse meat was responsible for the infection, though no meat could be examined.

Introduction

Trichinosis is now rare, although endemic cases have occurred in Switzerland,¹ Germany,² central Europe, Asia, Africa, the United States,³ and arctic areas. In France, although a few cases have persisted in animals, the disease completely disappeared in man after the last epidemic in 1878 due to improved hygiene and adequate food regulations. Recently some cases, all originating abroad, have occurred. In May 1975, 70 people were infected in

Egypt during a dinner at a resort centre, the correct diagnosis being established a few days after French tourists returned home.^{4,5} In January 1976 an outbreak occurred in the suburbs of Paris. We studied most of the patients affected, and describe here our findings, including the results of follow-up over 18 months. A preliminary report has already been published.⁶

Patients and methods

We studied 125 patients—that is, almost all those affected—comprising 95 adults and 30 children from 65 families. The ages of the patients ranged from 2½ to 86 years. They lived in a well-defined area a few miles south of Paris and were all admitted to the university hospitals of Bicêtre and Antoine Bécère. Clinical and laboratory data were collected following a detailed protocol under the constant supervision of one of us (PB). Muscle biopsy specimens were obtained (in adults only) with a Vim-Silvermann needle or surgically.

Results

ACUTE PHASE

Most of the patients (90) were admitted to hospital between 17 January and 5 February 1977, their symptoms at presentation being typical. The commonest symptoms were asthenia (83 patients; 66%), fever (81; 65%), headache (76; 61%), myalgia (74; 59%), and periorbital oedema (71; 57%). These were severe in 25 (20%) of the cases. Less common findings were nausea (40 patients; 32%), conjunctivitis (39; 31%), arthralgia (38; 30%), abdominal pain (33; 26%), and an enlarged spleen (10; 8%) or liver (3; 2%). Diarrhoea, usually a common finding, was not observed in any of our patients, while constipation occurred in 60 (48%). An increased eosinophil count was found in 121 (97%) cases, absolute counts being $0.35 \times 10^9 - 3 \times 10^9/l$ ($350-3000/mm^3$) in 95 (75%) cases and $3 \times 10^9 - 8 \times 10^9/l$ ($3000-8000/mm^3$) in 26 (20%); four patients had borderline or normal values. In adults the erythrocyte sedimentation rate was increased roughly as in fever; it was increased in only four of the 30 children, however, though fever could be pronounced.

The serum concentrations of muscular enzymes, lactate dehydrogenase, aldolase, and creatine phosphokinase were increased in 116 (93%), 75 (60%), and 58 (46%) patients respectively. In contrast, only four out of 52 electromyograms were modified with myogenic alterations without neurogenic disturbances. Muscle biopsy (32 specimens) showed non-specific myositis in 18 (57%) cases and larvae in only three. Non-specific biological changes included an increased leucocyte count (90 patients; 72%), increased serum concentrations of α_2 - and γ -globulins,⁷ and a decrease in serum calcium concentration. This

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last, observed in 114 cases (91%), was transient and clinically well tolerated. We tentatively postulate that this hypocalcaemia was due to precipitation of serum calcium by phosphorus released from muscle cells. Serum phosphorus and urinary calcium and phosphorus concentrations were not appreciably altered. Immunological investigations using immunofluorescence yielded positive results with trichinella antigen (Professor Gentilini) in 54 cases (43%), but cross-reactions were remarkable, since 51 (41%) of the sera were likewise positive for bilharzia antigen, 44 (35%) for filaria antigen, and 14 (11%) for ascaris antigen.

FOLLOW-UP STUDIES

Despite severe clinical symptoms in some cases, no death occurred. Most of the symptoms disappeared in under one month. Headache, asthenia, and myalgia persisted for three to six months in a few patients. Most biological values returned to normal within one month. The eosinophil count remained high for three to four months. Immunological disturbances were maximum during the first month, and serum titres decreased slowly over several months. The peak titres (1/400 to 1/25 000) and the duration of titres that were appreciably different from normal (from six to over 18 months) varied appreciably between patients and did not parallel the severity of the clinical picture. In one patient without symptoms a larva was found in a muscle biopsy specimen 18 months after the infection, the serum antibody titre being 1/800. In children the signs were mild as compared with those in adults and the abnormal biological parameters resolved more quickly.

Discussion

This was a relatively large outbreak of trichinosis. The clinical findings included in most cases two or more of the following symptoms: fever, headache, myalgia, periorbital oedema, and nausea. When associated with pronounced eosinophilia these signs were highly suggestive of the disease.⁸ In other reported series (table I) the same symptoms have occurred but in widely varying proportions. Diarrhoea, for instance, was virtually

TABLE I—Percentage incidence of clinical signs and symptoms in outbreaks of trichinosis since 1865

Signs and symptoms	Krats, 1865 ¹⁵ (n = 280)	Shook-hoff et al., 1946 ¹⁶ (n = 84)	Oppen-heim et al., 1947 ¹⁷ (n = 256)	Hatha-way, 1947 ¹⁸ (n = 83)	Wasser-man, 1951 ¹⁹ (n = 50)	Henne-keuser et al., 1968 ² (n = 47)	Present series (n = 125)
Fever	..	71	90	100	96	79	65
Myalgia .. .	92	72	74	93	68	89	59
Facial oedema ..	75	81	70	87	66	57	57
Conjunctivitis ..	..	..	33	..	..	..	31
Diarrhoea .. .	42	27	6	..	..	23	16
Constipation ..	..	..	..	..	..	30	42
Nausea .. .	..	13	16	..	54	..	32
Vomiting .. .	13	9	..	..	..	30	8
Abdominal pain ..	..	..	8	..	..	..	26
Headache .. .	..	23	88	..	..	..	60
Rash .. .	14	5	..	..	..	21	5

absent in our series but was common in others. Whether clinical signs are related to the severity of the parasitic infection remains to be established. The most suggestive laboratory findings include increased blood eosinophil counts and serum concentrations of muscular enzymes and the presence of specific antibodies against trichinella, though the latter takes longer to establish than clinical and other laboratory findings. Immunofluorescence methods⁹ and precipitation processes (double diffusion in agar) give earlier results than Roth's test or other methods. Cross-reactions between trichinosis and bilharziasis or filariasis, found in the patients infected in Egypt in 1975,¹⁰ occurred in our series. Since none of our patients had travelled overseas we knew that these cross-reactions were not related to multiple parasitic contaminations. Fluorescence staining on adult schistosoma sections of serum from our patients had a mottled appearance, whereas when the serum of patients with bilharziasis was used the fluorescence obtained was diffuse and homogeneous.

The parasite was found in only three out of 32 muscle biopsy specimens. The failure rate was high because the specimens were obtained during the first month of the disease, before the larvae had become encysted. A living larva was found in a cyst in a muscle biopsy specimen taken 18 months after the first signs of the disease: this shows the extreme longevity of the encysted worm. In this patient calcified cysts could not be seen on x-ray films, and xerography,¹¹ which is possibly more sensitive, was not performed. In the children the clinical signs disappeared quickly and the eosinophil count and serological reactions returned to normal in under six months. This observation confirms that morbidity and mortality in trichinosis are appreciably lower in children than adults.¹² The reason for this is not clear, although it may be that children are usually less heavily infected or eliminate adult worms more quickly due to the shorter length of their digestive tract, or both.

The anthelmintic drugs used for treatment were thiabendazole and fluormebendazole, the latter being particularly well tolerated even at high dosage. Short-term corticosteroid treatment was used only in the most severely affected patients when anthelmintic and symptomatic treatment had no effect. No deaths occurred. In previous studies the death rate has varied (table II).

TABLE II—Mortality during outbreaks of trichinosis since 1860

Year of study	Country or area	No of patients	Mortality (%)
1860-77 ²⁰	Europe	3044	7.5
1863 ²¹	Germany (Hettstadt)	158	17
1865 ²¹	Germany (Hedersleben)	377	26.7
1900-15 ²¹	Spain	372	7.5
1921-62 ²¹	Bulgaria	525	1.9
1930 ²	Germany	88	13.6
1940 ²¹	Yugoslavia	71	9.8
1946-52 ²⁰	USA	2695	3
1947 ²¹	Greenland	300	11
1950 ²	Germany (Rheinland)	30	10
1956 ²	Germany (Westfalen)	436	0
1953-67 ²⁰	USA	3220	1.6
1967 ²	Germany (Hesse)	47	2.1
1970 ²²	Canada	29	6.9
1973 ²³	USA (New York)	23	4.3
1975 ⁴	Egypt	70	0
1975 ¹⁴	Italy	89	0
1976 (present series)	France	125	0

Locations of patients with trichinosis and butchers.
● = Patient. □ = Shopping centre. △ = Small market.

Epidemiological study showed that a large proportion of the patients in the present series lived in two particular areas (figure). Most of the cases clustered around a large shopping centre and a small market a few miles apart. The data obtained by the veterinary inquiry suggested that horse meat was the source of the epidemics.¹³ All other meat was free from parasites, and all the patients had eaten horse meat in January 1976. Butchers specialising in horse meat were found in both the shopping centre and the market. The market butcher and his family were infected. Although horse meat was incriminated in an Italian outbreak,¹⁴ this pathogenetic mechanism is surprising since the horse is strictly herbivorous. A tentative explanation is that the horses were infected by hay contaminated with droppings of infected rodents. Since the horse meat had been imported from an eastern country and had all been eaten when we came to this unusual conclusion we could not examine it, and thus indisputable proof is lacking.

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SHORT REPORTS

Pronounced increase in serum creatinine concentration after eating cooked meat

Sporadic reports suggest that the serum creatinine concentration may increase after meals,¹⁻³ though it is generally believed to be unaffected by diet.⁴ This is also stated in a standard laboratory handbook⁵ and many textbooks on nephrology. We therefore report significant increases in postprandial serum creatinine concentrations observed in healthy volunteers fed cooked meat.

Subjects, methods, and results

After eating goulash six healthy male medical students were found to have noticeably increased serum creatinine concentrations, maximal values occurring three hours after starting the meal. We therefore decided to examine the effect on serum creatinine concentrations of the following five meals: (A) 300 g raw beef; (B) 300 g fried beef thoroughly cooked (10 minutes); (C) 300 g beef boiled for one and a half hours; (D) 500 g goulash containing 250-300 g beef and cooked for one and a half hours; and (E) 500 g stew containing 250 g pork, cooked for one hour. Venous blood samples were taken just before and three hours after starting each meal. Serum creatinine was measured with an AutoAnalyzer (SMA 6/60) using a dialysis procedure and Jaffé's reaction. We used the method of paired comparison to test the significance of differences. Results are expressed as means $\pm$ SE of mean.

Raw beef had no effect on the mean serum creatinine concentration (see figure). Fried beef, however, produced a moderate increase (from 83.5 ± 5.6 to 109.5 ± 5.7 $\mu\text{mol/l}$ (0.94 ± 0.06 to 1.24 ± 0.06 mg/100 ml)— $P < 0.01$), but boiled beef and goulash resulted in pronounced and closely similar increases (from 86.7 ± 4.4 to 162.8 ± 7.3 $\mu\text{mol/l}$ (0.98 ± 0.05 to 1.84 ± 0.08 mg/100 ml) and 83.3 ± 4.7 to 166.8 ± 9.7 $\mu\text{mol/l}$ (0.94 ± 0.05 to 1.89 ± 0.11 mg/100 ml) respectively— $P < 0.001$). The pork stew also caused a pronounced increase in mean value (from 79.0 ± 3.0 to 147.0 ± 4.9 $\mu\text{mol/l}$ (0.89 ± 0.03 to 1.66 ± 0.06 mg/100 ml)— $P < 0.001$).

The upper limit of normal for the serum creatinine concentration is 110 $\mu\text{mol/l}$ (1.2 mg/100 ml); thus clearly pathological values occurred in these subjects after ordinary meals.

Comment

Our finding of significantly increased serum creatinine concentrations in normal men after eating cooked meat agrees with the observations made in 1951 by Camara et al.¹ They suggested that creatinine

Change in mean serum creatinine concentrations ($\pm$ SE of mean) in six normal men three hours after eating (A) 300 g raw beef, (B) 300 g fried beef thoroughly cooked, (C) 300 g boiled beef, (D) 500 g goulash containing 250-300 g beef, and (E) 500 g stew containing 250 g pork.

Conversion: SI to traditional units—Serum creatinine: 1 $\mu\text{mol/l}$ $\approx$ 0.01 mg/100 ml.

is produced from creatine in meat during cooking and is then eaten along with the meat. Our findings also explain the diurnal variation in serum creatinine concentrations reported by Pasternack and Kuhlback.³

Increased serum creatinine concentrations after meals should be evaluated with caution, especially in patients prone to sudden alterations in kidney function. Urinary creatinine excretion may vary with the amount of cooked meat eaten, and creatinine clearance values may be overestimated if blood samples are drawn in the morning, when the serum creatinine concentration is at its lowest.

We thank the kitchen staff at Aarhus Amtssygehus for much valuable help. Requests for reprints should be sent to Dr F K Jacobsen.

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