

# UPDATE — TRICHINOSIS

by

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One might summarize this paper by stating that *Trichinella spiralis* is alive and well and living in domestic swine.

The latest Annual Summary from the Center for Disease Control indicates that 284 cases were reported in 1975, with one death.<sup>1</sup> In 1947 when the disease first became reportable 451 cases occurred. Since that time the incidence has gradually declined to an annual mean of 133 cases for the years 1965 through 1974.

In 1947 fourteen deaths occurred. The total number of deaths from 1965 through 1974 was 16.

It is of interest that 69% of the cases reported for 1975 were detected by careful epidemiological investigations, including serological techniques, of 20 separate common source incidents that involved 2 or more cases each. Five of these accounted for 148, 52%, of the total number.

The source of infection, where identified, was pork from domestic swine in 186 cases (73%). Sausage accounted for 149 (92.6%) of the 161 cases in which the pork product was identified. Meat from wild animals was implicated in 33 cases. And, 34 cases involved ground beef which was apparently adulterated with pork since natural infection with *T. spiralis* is unknown in herbivores.

Schantz has reported on investigations that were initiated to determine the dimensions of the problem of pork-contaminated ground beef.<sup>2</sup> New Jersey officials found pork in 38% of ground beef samples from three of the four stores associated with 28 of the 1975 hamburger cases. In addition pork was found in 20% of ground beef samples from five of ten randomly chosen stores in central New Jersey.

As a followup, the Center for Disease Control coordinated a preliminary survey that examined two packaged ground beef samples from ten supermarkets in greater metropolitan areas of each of twelve states. This included 231 samples from 136 stores. Six percent of the samples contained pork. Eight percent of the stores had at least one pork contaminated sample.

The Minnesota State Department of Agriculture, in a similar survey, found 3% of 213 ground beef samples adulterated with pork.

The problem may have a number of possible causes. Pork may be added to ground beef deliberately or through use of common processing equipment. Mixtures of meat from the two species is sometimes prepared for use in the home in meat loaves or meat balls, and may be inadvertently mislabeled.

At any rate, these incidents and the studies that followed clearly point to a mechanism for infection of which we should all be aware.

The sudden surge in reported cases from 141 in 1974 to 284 in 1975 raises questions about the status of swine as an infection source. A high percentage of pork is commercially processed in a manner that destroys trichina. A large volume of uncured pork is frozen either for commercial distribution or for storage in the home. Most states actively prevent the feeding of raw garbage to swine. For many years the public has been advised, through media such as home economics classes, cookbooks and newspaper food sections, to cook pork to temperatures adequate to destroy *T. spiralis*. Why is it then that infected product seems to be waiting for the unwary? Why is it that an incidence of infection rather comparable to those of 30 years ago can occur with a much different incidence of deaths—15 in 1947 as opposed to one in 1975?

The knowledge of the biology and epidemiology of trichinosis is still far from complete. However, information that is available is very interesting. For example, it is estimated that the prevalence of trichinosis in grain-fed swine in the United States is 0.125% and 0.5% in those fed garbage.<sup>3</sup> About 1% of market swine are fed garbage.

In 1975, 73 million head of swine were slaughtered under federal inspection.<sup>4</sup> With a prevalence of 0.125% approximately 90,000 animals would have been infected. An average butcher hog is estimated to provide 360 servings of muscle tissue of 0.11 kg (0.25 lb) each.<sup>5, 6</sup> Thus 90,000 infected swine provided po-

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tentially 32.4 million human exposures in 1975 which resulted in only 284 reported clinical cases.

These 284 reported cases may represent only a fraction of the actual clinical and subclinical cases that occurred. Difficulty in diagnosing clinical cases may contribute to the low number of reported cases. While outbreaks involving more than one case are rather likely to be correctly diagnosed, sporadic infections, especially if mild, are usually not recognized.<sup>7</sup>

Another factor that must be considered is that many human infections may be caused by larval doses too low to cause significant illness. In a recent study of 20,003 farm-raised swine 25 were found to be infected. Of these 68% contained less than one trichina per gram of diaphragm muscle. It is believed that approximately 70 live trichina must be ingested by a human to produce symptoms of infection.<sup>7</sup>

Further evidence for the possibility that a large number of subclinical infections may occur is found in another recent study of human diaphragms.<sup>5, 6</sup> All diaphragms in which live larvae were found, indicating recent infection, contained less than ten larvae per gram. Thirty-two of 42 of those with live larvae had less than one cyst per gram. Levels of less than one cyst per gram are believed to cause either negligible or no symptoms of infection.<sup>7</sup>

The human study provided rather convincing evidence that from 149,000 to 298,000 human trichinosis infections may occur each year.<sup>5, 6</sup> If that is true widespread low-level infections in swine may be very important in causing subclinical human infections.

A major objective of the Federal Meat and Poultry Inspection Program is to prevent the transmission of toxic or infectious disease agents from meat to humans. Disease agents like *Trichinella spiralis* obviously make that objective very difficult to achieve. Consider that the Program must inspect each of approximately 120 million mammalian and three billion avian food animals annually. Any system that would attempt to apply other than organoleptic inspection techniques would be extremely complicated. However, agents like *T. spiralis*, that produce no overt signs of disease in the affected animal cannot be detected by such gross examination.

Taking up the challenge, the Program set out in 1972 to develop an inspection system capable of detecting animals that bear certain agents of significance to human health but show no gross evidence of disease. Trichinosis was chosen as the model disease for the system.

A number of characteristics have been established as highly desirable:

- The cost per animal must be very low.
- The test must be compatible with the slaughtering rates and in-plant practices of the industry.
- The sensitivity must be adequate to detect animals that may be health hazards.
- The specificity must prevent unnecessary costs that could result from a large false positive rate.
- The technology must be within the capability of program inspection personnel.
- That the test should be capable of detecting more than one agent of importance.

After careful examination of currently available diagnostic systems for trichinosis it was determined that both trichinoscopic and digestion techniques fail in a number of respects to meet Program requirements. Serological systems were studied with the conclusion that both the Soluble Antigen Fluorescent Antibody Test and the Enzyme Labeled Antibody Test offer the required characteristics. Finally the ELA Test was chosen for development and automation. That work is now being carried out under the direction of Dr. Dale Holm of the Los Alamos Scientific Laboratories of the Energy Resources Development Agency at Los Alamos, New Mexico. The principal scientists involved are George C. Saunders, Elva H. Clinard, Mary Louise Bartlett and Mort Sanders.

The test is capable of screening for any agent that elicits humoral immune responses provided the causative antigen can be absorbed or otherwise bound to a suitable test vehicle. The time required for its completion is about 15 minutes. Whole blood or serum can be tested. Reagent cost is very low. The sensitivity is far superior to other systems and no insurmountable specificity problems have yet been noted. Finally, it appears that equipment exists that can be modified to automate the test.

Currently the testing system—reagents and equipment—are being readied for a field trial. The purpose will be to identify and characterize any problems that may occur when testing commercial swine. Approximately 80,000 porcine serum samples, from plants slaughtering garbage-fed swine, will be tested in an effort to identify 400 positive animals. Diaphragm samples will be examined by the pooled sample digestion technique for control purposes. When

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anomalous results, such as sero-negative digestion positive animals are found further studies will be conducted on tissue or serum in an attempt to understand the basis for the problem.

Beyond the field trial much work remains to be done before the system is ready for practical use. A suitable method must be developed for maintaining the identification of each animal with its corresponding test. Automated techniques for drawing blood samples and reacting them with antigen as soon after they are obtained as possible are under consideration. And, ultimately some method will be needed to utilize the epidemiological data produced to control the disease in swine.

It is expected that utilization of the system may require a number of modified approaches in order to accommodate all situations in which swine are slaughtered. Full automation may be required in high speed, high production plants while abattoirs slaughtering only a few animals per week may be handled using microtiter trays with hand-operated rubber bulb pipettes.

There is still no assurance that the system that we hope for will be achieved. Compromises may have to be made and alternatives considered. However, the potential values to be derived from the system are so great that the attempt must be made.

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### DISCUSSION

LARRY BORCHERT: I am sure Dr. Leighty would be glad to answer any questions you may have on this subject. Are there any?

RAY FIELD, Wyoming: I am interested in knowing

the species of wild animals involved in trichinosis and what the geographical location of these animals are?

JACK LEIGHTY: I am not familiar with all of the species that were involved in 1975. Generally, as you would suspect, it is largely bear meat. They are all carnivores or omnivores of one kind or another. The other part of the question dealing with different parts of the country, none of these pigs, incidentally, were farm-killed pigs. All the pork apparently came from either Federally inspected or custom slaughtered sources. In the hamburger incidents, a greater proportion of those were in New Jersey, a rather high percentage of them being clustered around one supermarket where housewives not acquainted with each other were involved in the consumption of raw hamburger. The other site of that area of outbreaks was at a country club that specialized in producing nice big rare hamburger patties and they succeeded in giving trichinosis to a lot of people. That meat all came from the same source. Again, there continues to be a relationship between persons of European background who like to eat rare, cold smoked sausage.

PAUL LEWIS, Arkansas: What is the source of contamination for the pigs not being fed garbage?

JACK LEIGHTY: I was a little bit sneaky on that. I added that sentence to the presentation and said a lot is not known about the biology and epidemiology of trichinosis. A lot of ideas are prevalent about that and I expect until we get better information that identifies an infected pig and its source we really will not know what are all of those sources of infection. Rats apparently have been incriminated and documented in the kind of literature we distribute to people but appear not to be very important. Whenever an outbreak occurs, whenever we find a herd that seems to be infected, and you start trapping rats and digesting them you do not find very much. People talk about rotten mouse manure. We know of a farm in Illinois that feeds elevator sweepings that has a very high manure content from rodents and one of the persons working on that project thinks the manure may contribute a good deal to the infection of these pigs. On the other hand, the pigs fed that kind of thing are often simply dying or eaten by other pigs. Such things as tail chewing go on that may cause infection or aborted fetuses may be eaten. We do not know much and the possibilities are many. Maybe it is a waste of time to study it too closely. It might be of greatest importance to find out the source of infected pigs and then try to selectively educate people to keep those pigs separated from any possible source of the disease.

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SAM PALUMBO, ERRC-USDA: This is sort of a philosophical question. According to the CDC survey that you mentioned, I think it said that basically more people have died from trichinosis in the last 25 years than have died from botulism, yet any death from botulism gets a very big play in the newspapers and deaths from trichinosis are barely noted. I was wondering if you would comment on this?

JACK LEIGHTY: I think probably there is not very much known about the epidemiology of botulism either. We are learning more all the time. It was not too long ago botulism was considered a fatal disease. We now know that that is not necessarily true.

We also know perhaps a lot of babies are dying from botulism because of some peculiar physiology of their gut which may allow its growth. Why something like the Cryopacking incident with the stew gets so much play and trichinosis does not get very much I do not know. It may be because botulism has kind of the arsenic idea. It is a dreaded poisoning, whereas trichinosis does not seem to kill very many people and if you have had it and survive you seem to recover pretty quickly. Probably a high percentage of us who are over 50 in this room are bearing the organism with no ill effects. That is philosophical and maybe not a very good answer but it is the best I can give.