

The Incidence of *Trichinella spiralis* in Humans of Iowa

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THE UNITED STATES has long been considered the primary focus of trichiniasis in the world. This unenviable position resulted in restrictions placed against the importation of United States pork as early as 1879, only 44 years after the parasite was first recognized. These restrictions persist even today in many countries. Studies in the United States during the 1930's and early 1940's (1), which revealed that 16 percent of the human cadavers examined were infected with trichinae sometime during their lifetime, reemphasized the problem.

However, while only limited studies have been made in the last two decades, these have indicated a declining human incidence. In a recent review, Most (2) presented data indicating an incidence of 4.5 percent in 990 human diaphragms examined during 1948-63 in the United States. The incidence in three selected cities declined from 19.6 percent prior to 1942 to 4.3 percent during 1950-61. This apparent decline is also supported by a decline in the number of cases of human trichiniasis reported in the United States. During 1944-48 a yearly average of 400 cases was reported (3), while the yearly average declined to 202 cases during 1960-64 (4). These averages exclude Alaska and Hawaii which were not included in earlier

records. During 1965, the cases reported totaled 199 according to a Communicable Disease Center report (5).

The incidence of trichiniasis in swine is similarly declining. A recent national study revealed an incidence of 0.12 percent in 9,495 farm-raised, butcher-weight swine, 0.22 percent in 6,881 farm-raised, breeder swine, and 2.2 percent in 5,041 garbage-fed swine (6). The results indicated that the incidence in garbage-fed swine, which represent only about 1.5 percent of the swine slaughtered in the United States, is beginning to decline rapidly.

Since Iowa produces about 20 percent of the swine raised in the United States, various phases of the trichiniasis problem in Iowa have been examined during the past decade. Determinations of the extent of trichiniasis have been made in swine (6, 7), pork sausage (8), wildlife (9), and dogs and cats (10). To more fully evaluate the problem in Iowa, these studies were expanded to include human beings.

Materials and Methods

Two hundred eighty-five diaphragms were obtained during autopsies by cooperating pathologists throughout Iowa. During the first phase of the study, which extended from November 1961 through August 1963 and involved a Veteran's Administration hospital and 2 general hospitals, 140 samples were examined. The second phase, extending from February 1964 through April 1965, involved at least 14 hos-

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pitals in all sections of the State including 1 VA hospital, 2 mental health institutions, and at least 11 general hospitals. Some pathologists serviced several smaller hospitals.

The diaphragm samples were examined by two methods—the artificial digestion-Baermann method and the trichoscopic method. The artificial digestion method utilized was similar to one described previously (8). However, a 20-mesh screen was used in the large Baermann funnel instead of an 80-mesh screen to allow passage of calcified cysts which had withstood the digestive action. The samples varied in size from 5 to 90 grams, but most fell in the 30–50 gram range. Trichoscopic examination, made by means of a Leitz trichoscope, 1Xq, model 2, was performed on 0.5 gram portions of diaphragm cut into 28 pieces and compressed between the glass plates of a compression slide.

In addition to the 285 samples included in this study, 34 embalmed diaphragm samples were examined in phase one with negative results. However since the embalming process was found to interfere with the digestion process used, these results were not recorded. Embalmed samples were not examined in phase two.

Results

The results of these studies, shown in the table, indicate that the incidence of human trichiniasis in Iowa was relatively low (2.8 percent).

To further evaluate these results, incidence is shown by sex, residence, color, and age. All positive specimens were from males. A primary reason for this was the abnormally high percentage of males examined as compared to actual mortality rates. The large number of samples from the two VA hospitals account for most of this discrepancy in sampling.

A somewhat higher incidence rate was noted for those classified as urban residents. But again the sample was weighted abnormally toward urban residency. Since nearly 99 percent of the Iowa mortality was represented by whites, it was not, therefore, surprising to find that all infected persons were white.

The age at death of the persons from whom the infected samples were obtained revealed a definite age-incidence relationship of trichinae

infections, with all infections in the older age groups. The ages of the eight persons found infected were 52, 60, 60, 60, 61, 70, 75, and 84 years.

All positive specimens were detected by the artificial digestion-Baermann technique. Seven of the positives contained only cysts, with various stages of calcification present. The eighth contained eight living trichinae. Four of the eight positive samples were also detected by the trichoscopic technique.

The number of trichinae per gram of infected diaphragm as determined by the digestion method was relatively small. Only two of the eight infected samples contained more than one per gram (7.5 cysts per gram in one and 3.0 per gram in the other). The finding of four positives by the trichoscopic method indicated that two other samples also contained more than one larva or cyst per gram.

No relationship of occupation to infection could be determined. The primary occupations represented in the infected group were chauffeur, press operator, cream hauler, carpenter, gasoline station manager, laborer, and bartender. The eighth occupation was unknown.

Discussion

A major study of trichiniasis in the United States conducted by the National Institutes of Health, Public Health Service, during 1937–44 examined 5,313 samples with an overall incidence of 16.1 percent (11). Included in that study were 37 samples from Iowa with 7 (18.9 percent) containing trichinae. This is in marked contrast to the findings in the current study when an overall incidence of 2.8 percent was obtained from 285 diaphragms examined. This decrease in incidence becomes even more meaningful when it is realized that only one of eight infected samples contained living larvae. Gould (1) stated that calcification generally does not begin until 6 to 18 months post infection. Living trichinae were found within calcified cysts believed acquired up to 31 years previously (12). This indicated that only 1 of the 285 persons from whom the diaphragms were obtained might have been infected in the 6 months before death, and this infection might have been acquired even two or three decades before.

Incidence of *Trichinella spiralis* in humans of Iowa, 1961-65

Classification	Number examined	Number positive	Percent positive
Sex:			
Male.....	210	8	3.8
Female.....	61	0	-----
Unknown.....	14	0	-----
Residence:			
Rural.....	48	1	2.1
Urban.....	183	6	3.3
Unknown.....	54	1	1.9
Race:			
White.....	282	8	2.8
Nonwhite.....	3	0	-----
Age, years:			
Under 1.....	2	0	-----
1-4.....	0	0	-----
5-14.....	4	0	-----
15-24.....	6	0	-----
25-34.....	12	0	-----
35-44.....	22	0	-----
45-54.....	35	1	2.9
55-64.....	59	4	6.8
65-74.....	87	1	1.1
75-84.....	33	2	6.1
85 and over.....	6	0	-----
Unknown.....	19	0	-----
Total.....	285	8	2.8

The possibility that most of the infections detected were acquired in earlier years was supported by the age-incidence relationships derived. The youngest infected person at death was 52 years of age and the other seven ranged in age from 60 to 84 years. This observation is in marked contrast with the previously cited study of trichiniasis in the United States (11) when an incidence of 12.6 percent was found for 1-44-year-age groups as compared to 18.3 percent for 45 years and over. The relatively high incidences in all age groups in that study, along with the finding that 45 percent of the positives contained all or some living trichinae, indicated that many of the infections three decades ago were relatively recent. Although the sample size for the younger age groups was relatively small, the failure to find any infections in younger people in the current study may indicate a declining trichiniasis problem in humans of Iowa. This age-incidence relationship is not surprising since the longer a person lives, the greater are his changes of eating infected pork.

The relatively low incidence correlated with other findings concerning trichiniasis in Iowa.

Zimmermann and Brandly (6) reported an incidence of only 0.044 percent in Iowa swine examined during the 1961-65 period, while earlier studies had shown an incidence of 0.16 percent during the 1953-57 period (7). Similarly, infected pork sausage available in Iowa declined in incidence from 12.0 percent during 1944-46 to 1.0 percent during 1953-60 (8). These trends tend to indicate that trichiniasis is decreasing as a health hazard in Iowa.

The low incidence of trichiniasis in humans of Iowa, when considered with the apparently decreasing incidences in other areas of the United States as cited by Most (2), indicates that the trichiniasis problem may be decreasing throughout the United States. This is now being investigated in studies directed by the author in collaboration with the Public Health Service's Communicable Disease Center. A statistically designed study has been initiated with an approximate goal of 10,000 samples from all 50 States and the District of Columbia during the next 4 years. It is hoped that updated incidence values will give a truer picture of the current trichiniasis problem in the United States.

Preliminary data based on examination of more than 1,000 samples indicate a prevalence of less than 6 percent. All positive samples thus far obtained were from persons who had reached the fifth decade of life. These findings, along with the discovery of a predominance of calcified cysts in the cadavers examined, lend further support to the conclusion that the trichiniasis problem in the United States is decreasing rapidly.

Summary

Trichinae larvae or cysts were obtained from 8(2.8 percent) of 285 human diaphragms examined for *Trichinella spiralis* infections in Iowa during the period 1961-65. This is in marked contrast to a previous study by the National Institutes of Health, Public Health Service, during 1937-44 when 18.9 percent of 37 human diaphragm samples from Iowa contained trichinae.

Examinations were made by the artificial digestion-Baermann and the trichoscopic methods. All positives were found by the artificial digestion-Baermann method, and four

were also detected by the trichoscopic method. Living trichinae were obtained from one diaphragm, while the other seven positive samples contained only calcified cysts.

An age-incidence relationship was obtained with all infections in the older age groups. The eight infected persons ranged from 52 to 84 years of age at death. No definite relationships between sex, residence, and race were established.

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Audiovisual Collection at NLM

The Public Health Service's National Library of Medicine, Bethesda, Md., is broadening its audiovisual collection and developing facilities to enable medical researchers, practitioners, and educators to obtain medical information in this form.

As part of the first phase of the program, which is being implemented in cooperation with the Service's Audiovisual Facility and Communicable Disease Center, Atlanta, Ga., a new audiovisual carrel has been established in the library's main reading room. The carrel is equipped with two 8-mm. Fairchild Mark IV rear-screen motion picture projectors, with earphones for individual use. The projectors accommodate sound films which are mounted in cartridges and shelved in the carrel.

The films were produced during the past 2 years at the audiovisual facility in Atlanta. Subjects range from hemoglobin determination and rabies F-A staining (in a subseries on

microbiological techniques) to "Physiological Manifestations of Emphysema." Information on these films is provided on cards filed under subject and producer in the library's public catalog and in a separate catalog maintained in the carrel. The library intends to acquire all teaching films related to medicine for use in this new facility.

Plans are being made to include other audiovisual media and appropriate hardware. The library hopes eventually to establish a well-rounded basic collection of 35-mm. slides, 8-mm. and 16-mm. films, film strips, records, and audio and television tapes, and other programmed learning resources that will be available to individual users through a central audiovisual service center. This center would be a prototype facility to serve as a demonstration unit for evaluation by other medical libraries.