BRUCELLOSIS IN THE MEAT INDUSTRY*

by

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Introduction

Brucellosis is a systemic disease normally associated with the handling of infected animals or their tissues, or the ingestion of infected animal products, such as meat, milk, or cheese. It is caused by a group of gram-negative bacilli, called the Brucella, which commonly infect such animals as cattle, sheep, goats and pigs, generally localizing in the reproduction organs and mammary tissues.

Brucellosis is often referred to as Undulant Fever, Malta Fever, Mediterranean Fever, Bang's Disease, Texas Fever, or Hog Fever. The disease may have either an acute or insidious onset, and is characterized by continued or irregular fever of variable duration, headache, weakness, profuse sweating, chills, and general aching. Although its fatality rate is low, about 2%, recovery is often long and is accompanied by pronounced disability. It may last for several days, many months, or occasionally, for several years.

In the United States today, the disease is primarily associated with work operations in the slaughter and processing of animals, particularly swine. It has been almost completely eliminated from the country's cattle, sheep, and goat populations by effective immunization programs. This is not the case, however, with swine. In California, over the past several years, cases of brucellosis have occurred among swine slaughter house workers to a relatively unknown or questionable extent. Therefore, the California Department of Public Health, with the Departments of Industrial Relations and Agriculture, has been conducting epidemiological-environmental studies

to determine the prevalence of this disease; to pinpoint the major sources of infection; and to recommend effective control or elimination methods in the industry.

Description of California Study

The California study consisted of four phases:

1. The establishment of the prevalence of brucellosis in the hogs being slaughtered in California by the blood testing of representative animals during slaughter.

2. The determination of both the prevalence of presently or previously infected workers and the location of high risk areas in the plant by a serologic study of the workers in a major slaughter house.

3. An evaluation of the work environment in one or in major processing plants to determine the magnitude of airborne contamination due to pathogenic and non-pathogenic organisms.

4. An evaluation of the medical, clinical laboratory, and environmental control programs in the major meat processing plants of California.

This report will deal mainly with the environmental evaluation phase of the California Brucellosis Survey. However, I will summarize the general findings of the Animal Test Phase and the Medical Serological Phase of the study.

All swine bred in California are raised in counties which are validated as "free from brucellosis" except for one county. In that county, two herds are known to have brucellosis and both of these herds are under quarantine. Furthermore, the swine from these two herds are shipped out of California for slaughter. Incidentally, the State Department of Agriculture recently

amended by resolution on September 7, 1971, its regulations to adopt in Title 3 of the California Administration Code, Section 795.30 6 (c) a provision which states "on or after January 1, 1973, all swine moving within the State shall have originated in non-infected herds in validated brucellosis free areas."

Approximately 25% of the pork and pork products eaten in California is derived from hogs slaughtered in California. Of the approximately 1.6 million hogs slaughtered in California each year, about 90% or 1.4 million come in from the mid-western States. One of the two major plants in California slaughters approximately 5,000 to 6,000 hogs per day. As part of the Animal Test Program, every day for two months, 5% of the hogs slaughtered were serologically tested. This amounted to between 250-300 tests per day. The program confirmed the results of previous studies, both in California and in other parts of the country, that the average infection rate for swine is approximately 0.2%. This means that, if 8,000 hogs are slaughtered in a day, approximately 16 of the animals are potential sources of contagion to the plant workforce. Actually, the usual pattern is for a large group of infected animals to come in at one time, with periods of no infected animals for several days.

I would now like to discuss the environmental evaluation phase of the survey. It has been well established that the transmission of brucellosis from animal to man may occur by indirect or direct contact with the infected animal tissues. This contact may consist of (1) direct physical contact with the infected animals or their tissues through the intact or abraded skin; (2) contact with infected tissue through the mucous membrane or the conjunctiva of the eyes; (3) ingestion of contaminated, unpasteurized milk and dairy products

or infected meat products; or (4) inhalation of liquid or solid aerosols contaminated with brucella bacteria.

Dr. Buchanan and his associates in a recent study found a high correlation between human infection rates among meat packers and a term he calls the "contact coefficient." This "contact coefficient" can provide an estimate of the risk of the employees in developing brucellosis due to contact. It is the product of (1) the degree of employee arm or hand contact with animal blood or lymph in work activity (rated 0 to 10) and (2) the frequency of employee nicks, scratches, or cuts of the skin (rated 0-5).

Other studies indicate that the airborne route may also be a significant mechanism for infection, although most authorities consider it to be of much less importance than the direct contact route in the meat packing industry. An attempt was made, therefore, in the California study to detect the presence of brucella bacteria, in aerosol or droplet form, in the air of probable "high risk" areas of the plant surveyed.

Figures A and B show the flow diagram of the first phases of the hog slaughtering operations. In a previous study where similar operations were conducted, it was found that the high risk areas were consistently associated with the handling of freshly opened hogs, such as the hog-kill department, the hog-cutting departments, and the boning departments. Because this study was to be completed as expeditiously as possible, with a minimum of time and activity expenditure, we limited our sampling to these high risk areas. Additionally, we attempted to detect non-pathogenic bacteria in the air for use as an indicator of the presence of total bacterial contamination.

A major assist was given to us in this phase of the study by the staff of the Naval Bio-Medical Research Laboratory of the University of California in Oakland, particularly by Dr. Robert Heckley, Mr. Marc Chatigny, Dr. Hiram Wolochow, and Dr. Dan Eisler. Not only did they give us excellent advice on biological sampling techniques and strategy, but they also loaned us otherwise unavailable sampling equipment. They also carried out the sample culturing and identification phases of the evaluation.

Air samples were collected in all glass impingers (AGI-30); in four-stage Anderson stack samplers; and on settling plates which were placed at several strategic locations in the work rooms. Sets of samples were taken on two separate days, with the hope that they would coincide with days of positive findings of infected animals (if infected animals were, in fact, going to be detected). Strictly by chance, on one of the two days of sampling, an infected animal was identified.

The brucella bacteria are known to be gram-negatives, non-motile, and non-sporulating coccobacilli. Since they grow better in an enriched CO_2 environment, the collected samples were placed in an air-tight, sealable container, containing a stub of candle. Before the samples were sealed, the candles were lighted in the container, and then sealed, in order to build up the CO_2 atmosphere. The samples were then hand carried to the Naval Bio-Medical Research Laboratory in Oakland.

As shown in Table I, 24 samples were collected with a total air volume of 388 cubic feet. Although an abundance of bacteria was found in all samples collected, no brucella organisms were found in any of the samples. Most culture plates showed some growth of gram-negative bacteria, with some gram-positive cocci also identified. If time had permitted, we would have

taken additional samples in the "low risk" areas and made a greater attempt to quantitate the atmosphere concentrations of viable bacteria.

Ventilation studies were also conducted to evaluate the general air patterns within the work areas and to estimate general fresh air distribution within specific work areas. The flow of air from one room to another was a major concern if contaminated aerosols were found in any one work room.

General Industrial Hygiene and Sanitation Findings

1. As in the case of previous epidemiological studies of brucellosis in swine slaughtering plants around the country, it is apparent that brucellosis does exist in California plants and that the chief mode of transmission of the disease is by direct contact with infected animal tissues.

2. Although no brucella organisms were recovered from the air of the plant at the time of the study, the high degree of air concentration with gram-negative bacteria indicates that the possibility of airborne transmission of brucellosis to the workers cannot be ruled out. Other studies in swine slaughterhouses have shown that, when infected hogs are slaughtered, brucella organisms can be isolated from the work atmosphere. According to Constantine, the brucella are among those bacteria known to be transmitted to man by the respiratory route.

The following industrial hygiene and sanitation recommendations are being made to the slaughterhouse industry of California:

1. Since the primary source of brucellosis infection in the slaughterhouses is the presence of infected animals or their tissues, the fundamental preventive measure must be the elimination of infected hogs or other animals from the slaughterhouses by requiring the slaughter of animals only from

"certified free" herds or areas. This should be accomplished by the enforcement of the recently enacted Department of Agriculture regulation which will become effective on January 1, 1973.

2. Until "certified free" hogs are available, it must be presumed that all animals slaughtered are infected; so that personal protective measures and devices must be made available and used. (The USDA makes this assumption with respect to the status of the carcasses being prepared for human consumption until the carcasses are judged healthy according to USDA inspection standards.)

a) All personnel handling potentially infected animal tissues should have available impervious, disposable gloves and gauntlets to minimize infection through the abraded or intact skin. All cuts should be immediately cleansed and dressed with waterproof bandages. No worker with newly created cuts or abrasions should be permitted to handle fresh meat until the cut has healed.

b) Eye shields and goggles should be available for all workers exposed to potentially contaminated aerosols to minimize infection through the eyes and mucous membranes.

c) Disposable "dust-mist" respirators or masks should be available for all workers exposed to potentially contaminated aerosols to minimize infection through the respiratory tract. The American Optical "Dust Demon"; the 3M Company biological masks, "Filtron" and "Aseptic; and the "Bardie" Deseret Filter Mask" of the Deseret Pharmaceutical Company, all have excellent filtering properties for biologically active (liquid and solid) aerosols.

3. Since infection by brucella organisms can also occur by ingestion of infected meat or food contaminated by dirty hands, the use of locker rooms

as lunch rooms should be prohibited. Adequate washing facilities and lunch rooms are essential as prescribed in the latest regulations of the Department of Labor. /Sect. 1910.141 (g)(1) through (3)/.

Conclusion

Brucellosis is one of those diseases that receives relatively little attention because it is seldom fatal. Its symptoms are rarely dramatic, but unfortunately it is often very debilitating and of long duration. It may easily be mistaken for a number of other diseases. It is, however, a disease that presumably can be completely eradicated from a region, or from any segment of the population if sufficient effort and control is expended. Hopefully, the enforcement of the new Department of Agriculture regulations, effective January 1973, will eliminate brucellosis as a significant occupational disease in California. Until then, however, good hygienic practices; early and accurate diagnosis; and prompt and adequate treatment are the only useful measures in minimizing the effects of this disease.

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15. Supplementary Notes

16. Abstract (Limit: 200 words) Epidemiological and environmental studies were conducted in California in an effort to determine the prevalence of brucellosis, to pinpoint the major sources of infection, and to recommend effective control or elimination methods in the industry. The prevalence of brucellosis in hogs being slaughtered was determined by blood tests on a sample of animals being slaughtered. Studies of workers at various slaughterhouses confirmed the presence of brucellosis in California and confirmed that the chief mode of transmission was contact with infected animal tissue. Air analysis at several locations did not reveal the presence of brucella organisms. However, the high degree of airborne gram negative bacteria suggests that the airborne transmission of the disease under study cannot be ruled out. The author recommends that slaughterhouses handle animals only from certified herds or areas. Until such certified hogs are available, all animals slaughtered are to be assumed to be infected. Personal protective equipment must always be worn, including impervious, disposable gloves and gauntlets, and eye shields or goggles. Disposable dust mist respirators or masks should be used. No worker with newly created cuts or abrasions should handle fresh meat until the cut has healed. The use of locker rooms as lunch rooms must be prohibited. Adequate washing of the facilities and lunch rooms is essential.

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