Staphylococcal Infection in Meat Animals and Meat Workers

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ALTHOUGH most of the serious and fatal cases of staphylococcal disease in Seattle and King County, Wash., occur among hospitalized patients suffering from other diseases (*1–5*), several recent incidents suggested that the community has nonhospital reservoirs of staphylococcal infection which may be important in the ecology of staphylococci.

One such incident was an outbreak of boils (pyoderma) among workers in a poultry-processing establishment in Seattle. An investigation in October 1956 revealed that from May through September of that year 19 (63 percent) of the 30 poultry handlers in the establishment developed boils and other suppurative skin lesions. Most of the afflicted workers missed a few days from work, and several more than a week. Cultures prepared from specimens obtained from three patients with active lesions yielded coagulase-positive *Staphylococcus aureus*, bacteriophage type 52/42B/81 (now known as type 80/81).

Investigation of possible epidemiogenic factors revealed that this poultry plant began using an Acronizing process (chlortetracycline HCl) about May 15, 1956. The antibiotic replaced chlorine in the ice water bath in which the chickens were immersed for 4–6 hours after they were killed, cleaned, and eviscerated. It was claimed that the Acronizing process extended the "shelf life" of the poultry, permitting the holding of chickens at ordinary refrigerator temperature for as long as 14 days. Most of the workers, however, had little if any direct contact with the Acronizing process.

Investigation of the outbreak also revealed that abscesses, especially along the keel bone, were sometimes observed in chickens. The plant manager and sanitary inspector were instructed to submit any abscessed poultry carcasses for culture. One such bird, with an abscess along the keel bone, was submitted and yielded a coagulase-positive *S. aureus*, bacteriophage type 7. Letters were sent to the 21 growers who had supplied poultry to the processing plant during 1956 asking whether they had observed any unusual disease in their flocks and what antibiotics they had used in raising the poultry. Thirteen of the 15 growers who replied stated that they had used tetracycline in raising the chickens sold to this poultry plant. None, however, reported unusual or staphylococcal-like disease among their birds.

Another incident occurred in December 1959. At least 30 members of a carpenters' union became severely ill with staphylococcal food poisoning after eating ham at a union-sponsored dinner. Investigation revealed the following epidemiology: A tinned ham, purchased at a supermarket, was removed from its can, sliced by machine, wrapped in aluminum foil,

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and delivered to a woman who assisted with preparation of the meal. She baked the sliced ham, still wrapped in foil, for about 2½ hours at 300° F. and then left it at room temperature until it was served the following day. Coagulase-positive staphylococci, bacteriophage type 6/7/47/54/70/73/75, were isolated from (*a*) the remnant of canned ham served at the dinner, (*b*) a throat swab specimen from the cook who prepared (and also ate) the ham, (*c*) throat swab specimens (obtained after recovery) from two food-poisoning victims, and (*d*) swab specimens from infected cuts on the hands of two meat cutters in the supermarket, one of whom had sliced the ham. No viable staphylococci were isolated from a canned ham, not previously opened, from the same lot as the one causing food poisoning. On questioning, the meat cutters stated that knife cuts (which they inflict on themselves frequently) had become suppuratively infected about a month before the outbreak occurred. They also said that such infections, which they referred to as "pork infection," occurred most frequently in the spring and fall.

Apparently, the meat cutter inoculated the ham with pathogenic staphylococci while slicing the ham, and leaving the ham at room temperature after it was inadequately cooked permitted great multiplication of the organisms. The findings suggested that meat, particularly pork, might expose meat cutters to an occupational risk of stapylococcal infection of cuts.

A third incident took place in June 1960. At least three persons became severely ill with acute gastroenteritis several hours after eating ham sandwiches in a Seattle restaurant. These persons ate ham which had been cooked by exposure to infrared lamps for at least 18 hours and perhaps as long as 36 hours. The measured temperature of another ham similarly held under the infrared lamps was 112° F.

Laboratory examination of specimens of the implicated ham in this incident showed many gram-positive cocci by direct smear and a bacterial count of approximately 100 million organisms per gram of ham by culture. The only pathogenic organisms identified as part of the heavy bacterial growth were coagulase-positive *S. aureus*, which were not typable by means of bacteriophage. A specimen of an uncooked, refrigerated ham from the same restaurant revealed a few mixed, gram-positive bacteria by direct smear and approximately 1,000 organisms per gram of ham by culture. No coagulase-positive staphylococci were isolated from the refrigerated ham initially, but when a portion of the same specimen of ham was incubated at 35° C. for 36 hours it contained a bacterial count of more than 1 billion organisms per gram of ham, including coagulase-positive *S. aureus*, not typable by means of bacteriophage. Specimens of vomitus and stool from one hospitalized diner were examined. No coagulase-positive staphylococci were isolated from the vomitus, but coagulase-positive *S. aureus*, not typable by bacteriophage, was isolated from the stool. Furthermore, the specimens were negative for *Salmonella*, *Shigella*, and pathogenic *Escherichia coli*.

These findings indicated that the raw ham was lightly seeded with a variety of organisms, including pathogenic staphylococci, at the time it was received by the restaurant, and that the incubatory infrared lamps then caused great multiplication of organisms, especially the pathogenic staphylococci which caused the acute gastroenteritis.

These incidents suggested that considerable staphylococcal disease may derive, either directly or indirectly, from nonhuman reservoirs of infection. To explore this possibility, a study of staphylococcal infection in meat animals slaughtered in this community and in persons slaughtering these animals or processing the meat was made in the summer of 1960. The availability of an investigator with both veterinary and medical training (R.C.E.) greatly facilitated the undertaking.

Method of Investigation

The approximate number of meat-handling establishments in Seattle and the number of employees—slaughterers, cutters, boners, wrappers, sausage workers, packagers, and other handlers—was ascertained by means of questionnaires with the assistance of the six meat inspectors employed by the health department. The number of pounds of meat from animals slaughtered in Seattle and King County abattoirs was ascertained from city, State, and

Federal officials who routinely inspect these establishments.

To learn the nature and prevalence of staphylococcal infection among meat animals and meat workers, 15 establishments, including 2 slaughter, 5 wholesale, 3 poultry, and 5 fish establishments, were selected for intensive study. They were chosen because (*a*) they were located in Seattle, (*b*) they were among the largest of their respective kinds of establishments (there are only three poultry-processing houses in Seattle), and (*c*) their managements agreed to cooperate.

For each of 318 (all) workers having direct contact with raw meat in these 15 establishments, histories were obtained by direct personal interview. The histories covered job classification, employment tenure as a meat handler, and experience with boils and "blood poisoning," or "septicemia." The term "septicemia" is used in this article to denote wounds with associated inflammation, lymphangitis ("streaking"), and fever, necessitating medical treatment and referred to as "blood poisoning," "pork infection," or "fish poisoning" by the workers.

Each employee was also given a dermatological examination. Men were stripped to the waist; for women, the head, neck, and upper extremities were examined. Swab specimens for culture were obtained from any suppurative skin lesions observed and routinely from the nostrils. These specimens were immediately transported to the laboratory of the Seattle-King County Health Department and cultured by standard methods, using Chapman-Stone medium.

Abattoir inspectors were asked to save all suppurative lesions observed in meat and to notify the investigators. These specimens were also immediately taken to the laboratory of the Seattle-King County Health Department and

Table 1. Age, sex, and meat-handling experience of workers in selected meat establishments, 1960 survey, Seattle, Wash.

Type of establishment	Number of establishments	Number of workers			Average age (years)	Total number worker-years of meat-handling experience	Median number worker-years in meat handling
		Total	Male	Female			
Slaughterhouse	2	92	70	22	40	1,146	8.5
Wholesale meat house	5	85	55	30	36	917	6.0
Poultry house	3	77	26	51	40	690	6.0
Fish house	5	64	51	13	40	857	7.0
Total	15	318	202	116	39	3,610	7.0

Table 2. "Septicemic" [1] and suppurative illness reported by meat workers, 1960 survey, Seattle, Wash.

Type of establishment	Number of establishments	Number of workers	Workers reporting at least one episode of "septicemia"		Episodes of "septicemia"		Workers reporting boils or carbuncles	
			Number	Percent	Number	Per 1,000 worker-years	Number	Per 1,000 worker-years
Slaughterhouse	2	92	18	20	32	28	4	3.5
Wholesale meat house	5	85	18	21	46	50	1	1.1
Poultry house	3	77	6	7	7	10	4	5.8
Fish house	5	64	21	33	39	45	5	5.8
Total	15	318	63	20	124	34		3.9

[1] Wounds with associated inflammation, lymphangitis ("streaking"), and fever, necessitating medical treatment, and usually referred to as "blood poisoning," "pork infection," or "fish poisoning."

cultured by standard methods. Only meat with obvious pathological lesions was examined bacteriologically.

Coagulase-positive staphylococci isolated from lesions of workers and meat animals were typed by standard bacteriophage methods using the following 22 phages: 3A, 3B, 3C, 6, 7, 29, 42D, 42E, 47, 52, 52A, 53, 54, 55, 71, 75, 77, 79, 80, 81, 83, and 187.

Findings

Three hundred and seventy-nine meat-handling establishments in Seattle (including all six slaughterhouses located in King County outside the city) employed 2,929 meat handlers during 1959. These workers handled about 362 million pounds of meat during the year, consisting of 145 million pounds of beef, 51 million pounds of pork, 11 million pounds of lamb, 64 million pounds of poultry, and 91 million pounds of fish. Some of this meat was handled several times, for example, during slaughter, wholesale processing, and retail sale.

Characteristics of the 318 workers in the 15 meat-handling establishments studied intensively provide an indication of the population at risk in this occupation (table 1). Two hundred and two (64 percent) of the workers were men. Ages ranged from 17 to 71 years, with an average of 39 years. The 318 workers had worked an aggregate of 3,610 years as meat handlers and a median of 7 years.

Episodes of "Septicemia"

Eighteen (20 percent) of 92 workers in two Seattle abattoirs reported 32 episodes of "septicemia" while working in abattoirs, which

Table 3. Causes of wounds leading to "septicemia" [1] among meat workers, 1960 survey, Seattle, Wash.

Cause of lesions leading to "septicemia"	Slaughterhouses	Wholesale meat houses	Poultry houses	Fish houses	Total
Knife wound	21	21	5	6	53
Pork bone scratch	4	18	0	----	22
Bone scratch (species unknown)	0	6	0	----	6
Chicken bone wound	0	0	2	----	2
Fish bone or fin puncture	0	0	----	30	30
Burn (lard, etc.)	2	1	----	----	3
Cause unknown	5	----	----	3	8
Total	32	46	7	39	124

[1] Wounds with associated inflammation, lymphangitis ("streaking") and fever, necessitating medical treatment, and usually referred to as "blood poisoning," "pork infection," or "fish poisoning."

Table 4. Coagulase-positive staphylococci isolated from meat workers, 1960 survey, Seattle, Wash.

Type of establishment	Number of establishments	Number of workers	Workers yielding coagulase-positive staphylococci from nostrils		Number skin lesions cultured [1]	Lesions yielding coagulase-positive staphylococci	
			Number	Percent		Number	Percent
Slaughterhouse	2	92	26	28	14	8	57
Wholesale meat house	5	85	35	41	6	3	50
Poultry house	4	77	28	36	1	1	100
Fish house	5	64	13	20	5	3	60
Total	15	318	102	32	26	15	58

[1] Lesions were selected for culture by inspection of upper body (men only), head, neck, and upper extremities, and included minor infected cuts and lacerations, paronychia, and furuncles.

Table 5. Source and bacteriophage type of coagulase-positive staphylococci isolated from suppurative lesions of meat workers, 1960 survey, Seattle, Wash.

Type of establishment	Number skin lesions cultured	Lesions yielding coagulase-positive staphylococci		Type of lesion yielding coagulase-positive staphylococci	Bacteriophage type
		Number	Percent		
Slaughterhouse	14	8	57	Infected cut	Nontypable.
				Infected cut	7/54.
				Infected cut	6/47/54.
				Infected cut	7.
				Infected cut	53/80.
				Infected cut	Not phage typed.
				Bruised finger	Nontypable.
				Wrist dermatitis	29/52A/79/80.
Wholesale meat house	6	3	50	Infected cut	54.
				Infected cut	52/80.
				Infected cut	Not phage typed.
Poultry house	1	1	100	Bone puncture wound	53/77.
Fish house	5	3	60	Arm boil	29/52/80.
				Infected cut	187.
				Infected cut	Nontypable.
Total	26	15	58		

amount to an attack rate of 28 "septicemic" episodes per 1,000 worker-years (table 2). Four (4.4 percent) of the workers reported experiencing boils or carbuncles, an attack rate of 3.5 per 1,000 worker-years. Fifty-two (57 percent) of the workers reported one or more episodes of miscellaneous skin lesions such as infected knife cuts, bone lacerations, and burns, but many of these lesions were trivial, making it impossible to quantitate the lesions accurately. Paronychia was a common affliction of abattoir workers, who referred to it vernacularly as "run-arounds."

Additional perspective concerning the frequency and causes of suppurative illness among abattoir workers was provided by a first-aid man who had worked 10 years in his present position and was well informed. He recalled two outbreaks of suppurative illness among the workers; one he attributed to a registered male nurse because the outbreak of suppurative wounds ceased when he left; the other outbreak, in 1960, began coincident with processing of deboned hams, with as many as 12 persons at one time being treated for suppurating wounds.

Eighteen (21 percent) of 85 workers in five wholesale meat establishments reported 46 episodes of "septicemia" during a total of 917 years of work, an attack rate of 50 episodes per 1,000 worker-years (table 2). Only one worker recalled having had boils or carbuncles while working in a wholesale meat establishment. Twenty-three (27 percent) of the wholesale meat workers reported minor infections of knife and bone wounds.

Of 77 workers in poultry-processing establishments, 6 (7 percent) reported seven episodes of "septicemia" during an aggregate exposure of 690 years, an attack rate of 10 episodes per 1,000 worker-years (table 2). Four (5.2 percent) of the workers reported having had boils or carbuncles while working with poultry, an attack rate of 5.8 incidents per 1,000 worker-years.

Of the four poultry workers who had boils, two had them in 1956 while working in the plant which used the chlortetracycline process. These were the only two poultry workers employed in that plant in 1956 who were still working in Seattle poultry-processing plants in 1960. One of the other two poultry workers reporting boils had had her boils and a carbuncle immediately after discharge from a Seattle hospital, where she had undergone a hysterectomy. The fourth worker, who reported having had three boils on his neck 2 years before, gave no indica-

tion of the source of his infection. Thirteen (17 percent) of the 77 poultry workers reported miscellaneous infected knife and bone wounds.

Twenty-one (33 percent) of 64 workers in fish-processing establishments reported 39 episodes of "septicemia," or "fish poisoning," an attack rate of 45 episodes per 1,000 worker-years (table 2). Five (7.8 percent) of the workers reported having had boils or carbuncles, an attack rate of 5.8 such episodes per 1,000 worker-years. One of these five stated that his boils began immediately after hospitalization for "fish poisoning" in 1924 and persisted for several years. The source of infection for the other four workers could not be ascertained. One worker reported recurrent boils of the perineum for 15 years.

Thirty (47 percent) of the 64 fish workers reported miscellaneous infected wounds while working with fish. These workers refer to inflamed bone and fin puncture wounds of their fingers as "starters," and they are wary lest such lesions progress to "fish poisoning." At the first sign of a "starter" most of them consult a physician, who usually treats such persons with systemic antibiotics. Before antibiotics were available, treatment usually consisted of thorough cleansing with soap and water, hot water-epsom salt soaks, and applications of various antiseptics.

Causes of Wounds

Paronychia and inflammation of knife and bone wounds occur more frequently while working with pork than with beef or lamb, according to many slaughterhouse workers and wholesale and retail meat cutters. This alleged greater likelihood of infection from pork occurs despite equal or greater exposure to beef and many lacerations from beef bones. Many workers refer to severely infected wounds and "septicemia" as "pork infection."

Table 6. Source and bacteriophage type of coagulase-positive staphylococci isolated from pathologic lesions of meat animals, 1960 survey, Seattle, Wash.

Meat animal	Number diseased animals cultured	Coagulase-positive staphylococci obtained		Lesions yielding coagulase-positive staphylococci	Bacteriophage type
		Number	Percent		
Cattle	17	4	23	Liver abscess	53/77.
				Liver and lung (pyemia)	7/54.
				Lung abscess	7/47/54/75.
				Pneumonia	7/47/54/75.
Swine	22	9	41	Maxillary lymph node	Nontypable.
				Maxillary abscess	Nontypable.
				Maxillary abscess	7/47/54/75.
				Maxillary abscess	7/47/54/75.
				Shoulder abscess	53/77.
				Pleura and kidney	77.
				Lung-pneumonia	Nontypable.
				Ear cut	Nontypable.
				Nasal swab	53/77.
Poultry	13	9	69	Breast abscess	Nontypable.
				Breast abscess	Nontypable.
				Breast abscess	70.
				Breast abscess	Nontypable.
				Leg arthritis	Nontypable.
				Leg arthritis	Nontypable.
				Leg lesion	Nontypable.
				Visceral tumor	Nontypable.
				Peritonitis	Nontypable.
Sheep	3	3	100	Prescapular lymph node	Nontypable.
				Lung abscess	Nontypable.
				Liver	77.
Total	55	25	45		

Among workers in abattoirs and wholesale meat establishments, 42 (54 percent) of 78 "septicemic" episodes were ascribed to knife wounds (table 3); 22 (61 percent) of the balance of 36 such episodes were attributed to pork bone scratches; and only 6 (17 percent) of these wounds were ascribed to other bone scratches.

Among workers in fish-processing establishments, 30 (77 percent) of 39 "septicemic" episodes were the result of lacerations caused by fish bones or fins. The workers usually ascribed the fish bone and fin lacerations that caused "septicemia" to certain fish, for example, red snapper, cod (ling, rock, and red), and sole, rather than salmon. Whether these impressions are correct and, if so, whether the difference is independent of the size and the bone and fin anatomy of the fish cannot be answered by this study.

Bacteriological Findings for Meat Workers

Of the 318 meat workers surveyed, 102 (32 percent) yielded coagulase-positive staphylococci from their nostrils (table 4). The staphylococcal carrier rates were roughly equal for each category of worker, except the rate among fish workers was slightly lower, a finding of doubtful significance.

Fifteen (58 percent) of 26 specimens taken from various minor lesions, for example, minor infected lacerations, paronychia, and furuncles, yielded coagulase-positive staphylococci. No major lesions were discerned on any of the workers examined. The minor lesions were observed with approximately equal frequency among the various categories of workers, except that only 1 of 77 poultry-processing plant workers had a skin lesion worthy of culture.

The yield of coagulase-positive staphylococci from the meat workers, according to source and bacteriophage type, is presented in table 5.

Bacteriological Findings in Meat Animals

Of 55 lesions of meat animals cultured, 25 (45 percent) yielded coagulase-positive staphylococci (table 6). Active suppurative lesions seemed more productive of staphylococci than the less active, but more obvious, encapsulated lesions routinely condemned by veterinary inspectors.

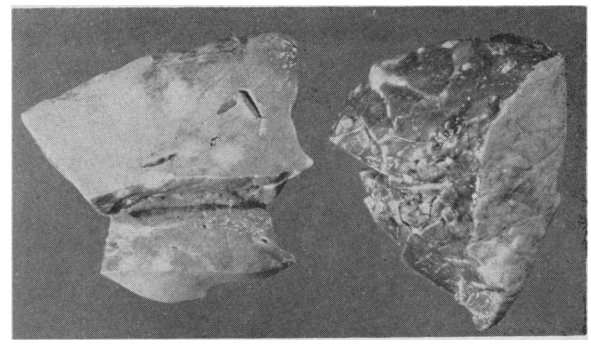

Figure 1. Staphylococcal abscesses (pyemia) of bovine liver and lung

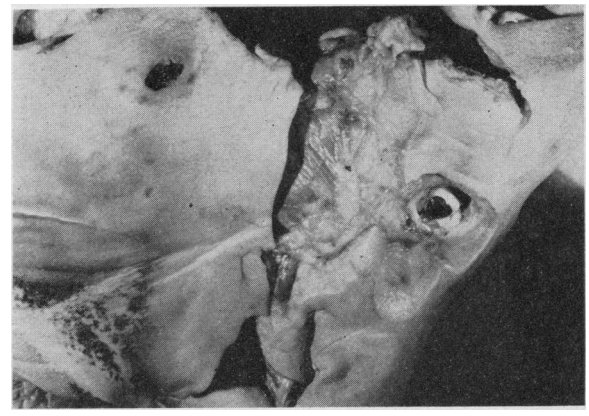

Figure 2. Staphylococcal abscess of porcine shoulder

The yield of coagulase-positive staphylococci from the meat animal lesions, according to source and bacteriophage type, is presented in table 6.

The pyemic liver and lung specimens, with multiple abscesses, from which type 7/54 staphylococci were isolated are shown in figure 1.

One of the isolations of type 53/77 staphylococci from pork was from a shoulder abscess (fig. 2) which may have resulted from vaccination. Maxillary lymph nodes of one hog's head, which was condemned as tuberculous, proved negative for tuberculosis by culture but yielded coagulase-positive staphylococci.

Interestingly, eight of the nine isolates of coagulase-positive staphylococci from poultry were not typable by means of the phages used; the single isolate identified was type 70. One of the nontypable strains of staphylococci isolated from poultry was from a diseased tibiometatarsal joint (fig. 3).

Staphylococci with phage patterns containing type 80 (commonly referred to as the 80/81 strain) were isolated from four human lesions but not from any meat animal lesions. Phage types 7/54 and 53/77 staphylococci were isolated from lesions of both animals and meat workers. With these exceptions no species-specific distribution of phage patterns is apparent except for the suggestively greater proportion of nontypable staphylococci isolated from poultry.

Phage type 7/47/54/75 staphylococcus, isolated from both bovine and porcine lesions, is similar to but not identical with the type 6/7/47/54/70/73/75 staphylococcus which caused one of the food poisoning incidents described in the introduction. Type 7/47/54/75 staphylococcus was also isolated with moderate frequency from lesions at antemortem and postmortem examinations of persons hospitalized in Seattle during 1960, according to an unpublished study by Ravenholt and Mulhern.

Discussion

The outbreak of boils among workers in a poultry-processing plant described in the introduction is the only such outbreak in this community in at least the last 15 years, according to the poultry sanitarian, the plant managers, and the histories obtained from the 77 poultry workers. That outbreak coincided in time and place with the use of the chlortetracycline process, which was discontinued shortly thereafter. No other poultry-processing plant in this community has used tetracycline in a similar manner. These findings suggest that the use of tetracycline in the processing of poultry somehow caused the outbreak of type 80/81 staphylococcal pyoderma, and if so, that possibly hospital outbreaks of type 80/81 staphylococcal infection are in some way, not yet defined, related to the use of tetracycline in that environment.

Findings from several outbreaks of staphylococcal food poisoning, including the two described in the introduction and others studied by Ravenholt, indicate that meat, perhaps especially pork, is not infrequently seeded with pathogenic staphylococci at the time of slaughter. This seeding may be an important factor in the epidemiogenesis of staphylococcal food poisoning. Certainly, staphyloccocal disease of meat animals does occur, and it seems likely that infected meat (especially when combined with poor temperature control) can serve as a source of staphylococcal infection for man. Furthermore, when meat handlers serve as the direct source of staphylococcal contamination of meat and other foods, they may perhaps do so as a result of occupationally acquired infection from meat.

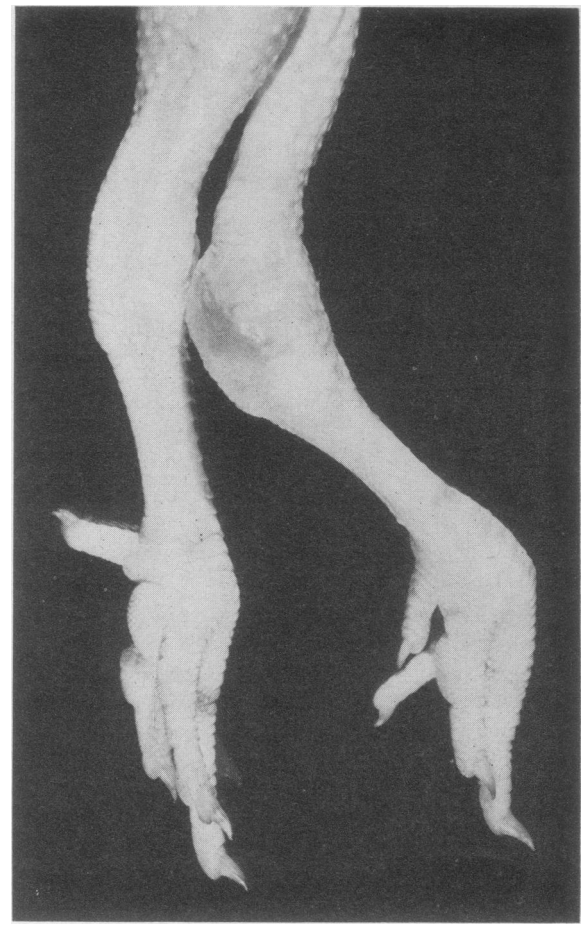

Figure 3. Staphylococcal arthritis of avian tibiometatarsal joint

Some animals do suffer from staphylococcal pyemia or septicemia at the time of slaughter. The frequency, distribution, and significance of such infections should be determined. What is the incidence of significant infection of various species of meat animals with various pathogenic staphylococci? In various areas? At various times of the year? And what causes

the incidence of such infection to vary? When these questions are answered, it may be possible to produce a more healthful meat supply.

The incidence of pyoderma recalled by the meat workers is undoubtedly less than actual experience because of memory loss and because workers with unusually great difficulty would probably seek other employment.

The cutaneous lesions and episodes recalled by meat workers in this study were undoubtedly caused by more than one type of micro-organism, perhaps including *Erysipelothrix rhusiopathiae*, which is known to cause erysipeloid of meat workers (*6*) and which would not have been detected by the cultural methods employed.

The failure to isolate type 80/81 staphylococcus from meat animal lesions contrasts with the frequency with which this type has been recovered from human lesions in this and other studies (*1,2*), and suggests that type 80/81 may be especially a human pathogen. It is perhaps significant that in several instances where type 80/81 staphylococcus has caused bovine mastitis, the infection has apparently been acquired from closely associated humans (*7–9*). In an early study of the relationship of human and animal staphylococcal disease, Smith (*10*) isolated one type of staphylococcus from human and bovine mastitis, but at that time (1948) type 80/81 staphylococcus had not yet been identified as such, and so his study does not provide a measure of the occurrence of this type among animals. Rountree et al. (*11*) did not report any type 80/81 staphylococcus among the "human" types they isolated from various domestic animals in Australia in 1956, though they did isolate type 6/47/54/75 staphylococcus from guinea pigs, which is the same type as the 7/47/54/75 isolated from bovine and porcine lesions in the current study. Similarly, Seto and Wilson (*12*) did not report any type 80/81 staphylococcus among the 102 cultures of bovine origin which they tested with type 81 phage in Wisconsin in 1958.

Certainly, for humans, type 80/81 is generally the most virulent and pathogenic of currently prevalent staphylococci (*1–5*). In addition, it appears to possess unique mammopathic qualities, as indicated by its propensity to cause bovine mastitis (*7–9*) and by its unfailing presence in outbreaks of nursery-derived staphylococcal disease which include breast abscesses of newborn infants as well as of their mothers (*1–5*).

It may be that the relationship of type 80/81 staphylococcus to all staphylococci and man is somewhat analogous to that of *Salmonella typhi* to all salmonellae and man. If so, the means and ease of controlling type 80/81 staphylococcus and other staphylococci may differ. For example, if type 80/81 were identified as the cause of a food poisoning outbreak from eating meat, one should perhaps seek the source of the outbreak especially among the foodhandlers, whereas if the outbreak were caused by another type, such as 7/47/54/75, one should perhaps suspect that the meat may have been seeded with the causative organism before it entered the kitchen. Similarly, infection of a newborn infant or a wound with type 80/81 staphylococcus should perhaps suggest the hospital or at least another human as the source, regardless of the antibiogram of the organism. It may be possible to greatly reduce the prevalence of type 80/81 staphylococcus in a community by prevention of hospital-acquired infection, without affecting the prevalence of other types. Further and much more extensive study of the distribution of various types of staphylococci according to species of animal is needed to answer the questions raised by this study.

The findings of this study do indicate clearly, however, that meat animals are frequently infected with pathogenic staphylococci at slaughter. Therefore, prevention of food poisoning is particularly dependent on proper temperature control of meat rather than on identification and control of infected food handlers.

Summary

An outbreak of boils and carbuncles among workers in a poultry-processing plant in 1956 in Seattle, Wash., and the findings of investigations of several outbreaks of food poisoning in the community in recent years suggested that considerable staphylococcal disease may derive from nonhuman reservoirs of infection. To explore this possibility, an investigation of staphylococcal disease of meat animals and meat workers was undertaken in 1960.

Histories of suppurative illness and swab

specimens of skin lesions (when present) and nostrils (routinely) were obtained from 318 meat workers in 15 meat-handling establishments in Seattle. These workers reported 124 episodes of "septicemia," an attack rate of 34 per 1,000 worker-years. Many of them stated that pork bone lacerations seemed more likely to become infected than lacerations from other causes.

Coagulase-positive staphylococci were obtained from the nostrils of 102 (32 percent) of the 318 workers.

A considerable variety of staphylococci were isolated from lesions of meat animals and meat workers. But type 80/81 staphylococcus, which was isolated from lesions of four workers, was not isolated from any of the animal lesions.

From these and other findings reported in the literature, we suggest that type 80/81 staphylococcus is primarily a human pathogen, with unique pathogenic and especially mammopathic qualities and that its relationship to other staphylococci and man may be somewhat analogous to that of *Salmonella typhi* to other salmonellae and man. Conversely, certain other types of staphylococci may primarily parasitize certain other animal species and only secondarily afflict humans.

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