

Fatal Staphylococcus Intoxication from Goat Milk

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DURING the past decade there have been numerous reports of outbreaks of food poisoning due to Staphylococci. While such outbreaks are relatively common and frequently involve large numbers of people, fatalities are rare. In the timely summary entitled "Food Poisoning," by Dack² the statement is made that "Staphylococcus food poisoning in otherwise normal individuals is not fatal." While the incidence of fatalities is very small indeed, we believe there are records of apparently valid cases of fatal intoxication due to the ingestion of Staphylococci and their toxic products.

Dorling⁴ cites the case of an elderly individual dying 24 hours after eating the remainder of a can of soup opened 1 week previously. The patient had a whitlow on the left thumb at the time the can was opened. The soup had been kept at room temperature after opening the can. The onset of illness began with violent vomiting and diarrhea 3 hours after eating the soup. Post-mortem examination showed an inflammation of the gastric and intestinal mucosa. The gastrointestinal tract was filled with a thin ochre-colored fluid containing many Staphylococci similar to the organisms found inside the tin can. No Salmonella or similar pathogens could be isolated. The evidence in this case strongly suggests but does not prove that Staphy-

lococci were etiologically related to the illness.

Blackman¹ describes the case of a 12 year old colored girl who developed "vomiting, fever, headache, diarrhea, vertical nystagmus, fine tremor of the iris (hippus), spasticity and general collapse" 5 hours after eating a large Thanksgiving dinner. Death occurred 36 hours after the onset of illness. Post-mortem examination revealed "acute diffuse enteritis of ileum and jejunum, 'diphtheric membranes,' molds of ileum and jejunum, septicemia (*Staphylococcus albus*), thrombi in small vessels of intestine, liver, lung, kidney, vagina and lymph nodes, focal necroses in liver, spleen and bone marrow. Small hemorrhages in the stomach, colon, vagina, brain and meninges." There is some question in this case as to the fundamental nature of the etiology of the illness. The septicemia with numerous small thrombi and areas of focal necrosis diffusely distributed in the various organs suggest the condition was not due alone to the ingestion of many organisms and pre-formed toxins but more probably followed some unrecognized intra-abdominal staphylococcal infection.

Denys³ reported in 1894 one fatality in an outbreak involving several families, only two of which were interviewed for epidemiologic data. In this instance illness followed the eating of meat from

a cow which had suffered from puerperal sepsis. Symptoms included malaise, nausea, vomiting, diarrhea, abdominal pain, and prostration, with death following on the 3rd day. Bacteriological studies revealed many Staphylococci of both aureus and albus varieties, the latter predominating. Post-mortem examination in the one fatal case 3 days after death revealed much decomposition, moderate congestion of the peritoneum and intestine, with marked congestion of the trachea, larynx, and bronchi. The respiratory mucosa was red and infiltrated with "sanguinous suffusions."

Finnel⁵ cited in 1856 the case of a woman "who had died from poisoning by eating soup made from mutton, which had been cooked in the house for five or six days. The entire family, consisting of five persons, were poisoned; but all except the mother recovered. After eating the soup, the patient vomited and purged violently and died in a collapsed condition. The tongue throughout the attack was white." The details of the autopsy findings were not given. While the clinical findings were compatible with what is now recognized as Staphylococcus intoxication, there are not enough data to substantiate this interpretation.

Taylor¹¹ one hundred years ago recorded a case clinically typical of Staphylococcus intoxication with severe abdominal griping, vomiting, purging, and prostration, with the onset 3 hours after the meal. Since this was 40 years before Rosenbach demonstrated the relationship of Staphylococci to purulent lesions there are not sufficient data to prove they were the cause of the illness.

Epidemiologic data *—In the familial outbreak to be reported it would appear that two fatalities were due to the

drinking of raw, unrefrigerated milk drawn from a goat suffering from a unilateral mastitis.

On March 16, 1942, at 6:00 P.M. the goat was milked and nothing unusual was noted except that 6½ pints were obtained in place of the usual 8 pints. At 9:00 P.M. Ernest H., father of Ruth and Robert mentioned later, drank ½ pint of the milk. At 10:30 P.M. he became acutely ill with continuous vomiting and purging. At 11:00 P.M. he called the local physician and, after treatment by him, the vomiting and purging ceased. However, he continued to feel exhausted and complained of blurring of vision and of difficulty in focusing for the next few days.

On the morning of March 17, 1942, approximately 12 hours later, Mrs. E. H. used part of the milk (unrefrigerated) to make biscuits and gravy. This was served to 7 adults and 4 children (16, 8, 4, and 3 years of age). In addition Ruth and Robert (3 and 4 years old, respectively) each drank ¼ pint of the milk. Cream from the milk was served in the coffee which the adults drank. One and one-half hours later Ruth and Robert, suddenly while playing on the floor, and without warning, started vomiting. Robert had marked purging. There were no other complaints. At 11:00 A.M. the local physician was consulted and a prescription was obtained. The nature of this is unknown. Their condition continued to become worse and another physician was called to the home. At 6:00 P.M., which was the regular milking time, the goat was found dead. At 3:00 A.M. on March 18, 1942, Ruth died without convulsions. Robert died on the way to the hospital at 7:00 A.M., less than 24 hours after drinking the milk.

All the persons involved had been accustomed to drinking goat milk daily. The owner, mother of Ernest H., recalled that the animal had had a scratch on a teat two weeks previously.

* Taken mainly from the formal report of the district health officer.

This had been treated with a carbolic salve until March 15, 1942.

Chemical examination of the viscera of the goat and of these two children failed to detect any type of recognizable poisons which might have given rise to the gastrointestinal symptoms. Tests for fluorides, oxalates, arsenic, mercury, and other heavy metals were made.

Gross Pathological Findings—The significant gross findings in the goat were limited to the udder, one side of which was greatly swollen, red, and firm. The teat from this side had been removed post-mortem, presumably by the local veterinarian who had been consulted concerning the cause of death. An incision into the swollen side revealed marked congestion with numerous dilated lactiferous ducts containing a light reddish-brown fluid suggestive of bloody milk. No definite grossly visible abscesses could be found. The kidneys showed a small amount of cloudy swelling.

In the two fatal human cases the hearts, lungs, livers, spleens, and kidneys showed no significant demonstrable gross abnormalities.

Microscopic examination—(Goat) The sections of the udder showed numerous small abscesses containing Gram-positive cocci. In many areas the lumina of the lactiferous ductules contained purulent material composed of polymorphonuclear leucocytes and many Gram-positive cocci. The liver showed a moderate amount of fatty degeneration around the central veins but no abscesses or focal collections of leucocytes were found. Sections of the kidneys showed necrosis of the tubular epithelium in the cortical portion with cell outlines being completely obliterated. The glomerular loops contained a moderate number of polymorphonuclear leucocytes. There was a diffuse polymorphonuclear infiltration between the tubules in the cortical region. There was only an occasional sub-capsular

collection of leucocytes suggestive of beginning abscess formation.

(Children) The lungs showed a moderate amount of pulmonary edema with marked congestion of the alveolar vessels. In a few areas there appeared to be definite hemorrhages into the alveolae. The heart showed no demonstrable histopathology. There was a small amount of leucocytic infiltration—mainly polymorphonuclear—in the peri-portal areas of the liver with a moderate amount of fatty degeneration around the central veins. There was a slight increase in the nuclear content of the glomerular loops but no cortical necrosis as was seen in the goat kidneys. The cortical necrosis reported⁶⁻¹⁰ to be found in the kidneys of animals dying from the effects of *Staphylococcus* toxin was not present in the organs from the children.

Bacteriological examination—Smears made directly from the part of the udder showing the mastitis revealed myriads of Gram-positive cocci in clusters. The organisms appeared to be as numerous as found in a full grown fluid culture of *Staphylococcus aureus*. Plates streaked for isolated colonies revealed enormous numbers of colonies of hemolytic *Staphylococcus aureus*. No other type of organism was found by smear or culture.

By careful aspiration and by making several sections through the udder it was possible to obtain about 10 ml. of light reddish-brown fluid suggestive of blood tinged milk. This was used for animal inoculation. The material was centrifuged to obtain a supernatant fluid free of bacteria and leucocytes. Kittens injected with this material reacted with vomiting and diarrhea typical of the reactions described as being due to *Staphylococcus* toxin.*

* Monkeys were not available for testing the material although they would have been preferred. Fresh normal goat milk was likewise not available but the need for this was obviated as shown in the immunological data.

It would have been interesting, in the light of epidemiologic data, to have determined whether the enterotoxin in this supernatant fluid recovered from the udder was thermolabile or thermostabile. However, the amount of material available was not sufficient to test both its thermolability and its immunological properties. Since our main problem was to demonstrate whether such material from the udder might be related to the cases of intoxication, it was decided to use the material for the immunization experiment.

Immunological investigations—Staphylococcus toxin was prepared by growing the homologous strain in semi-solid agar under 20 per cent CO₂. The filtrate injected into kittens produced typical syndromes of vomiting and diarrhea. A series of 6 kittens was divided so that 3 were immunized over a period of 4 weeks by starting with small doses subcutaneously and gradually increasing the amount until 0.5 ml. amounts were given. The other 3 served as controls. At the end of this time they were tested for immunity to the toxic principle in the material taken from the udder. Three immunized kittens injected with the supernatant fluid of the material taken from the goat's udder did not develop any gastrointestinal symptoms. The 3 control kittens receiving aliquot portions of the supernatant developed typical reactions with vomiting and diarrhea in 1 to 2 hours.

DISCUSSION

The symptoms exhibited by the patients were typical of those which have been produced in human volunteers consuming known cultures of Staphylococci. The history of injury to the teat, the presence of an extensive acute suppurative mastitis due to *Staphylococcus aureus*, the reproduction of the symptoms in kittens, the immunization against this toxic material in the udder

by using a filtrate of a culture of the homologous strain of *Staphylococcus aureus*, all indicate that the symptoms in the patients were due to the toxin of this organism. It is generally accepted by most investigators of this subject that a separate entity called enterotoxin is responsible for the symptoms of diarrhea, nausea, vomiting, and abdominal pain. Dack, *et al.* have not been able to produce gastrointestinal symptoms with filtrates not containing enterotoxin. However, this does not mean that under proper circumstances similar symptoms may not, at least sometimes, be effected by the so-called "lethal factor" which is thought to be responsible for the death of rabbits when injected intravenously. Whether the symptoms of collapse and prostration are related in part or entirely to the vomiting and diarrhea or to the effect of the lethal toxin is not certainly known. The production of symptoms in Ernest H. 3 hours after drawing the milk suggests but does not prove that the toxin was present in the milk at the time it was drawn. The cortical necrosis in the kidneys of the goat were similar to the reactions previously described as resulting from injury by the toxin of *Staphylococcus aureus*. The pathological findings in the children under the conditions of examination did not reveal anything which could be logically considered the cause of death.

SUMMARY

Data are presented to indicate that 3 patients developed food intoxication by drinking milk of a goat suffering from an acute suppurative mastitis due to *Staphylococcus aureus*. Two of the patients (3 and 4 years old) died within 24 hours after each drank $\frac{1}{4}$ pint of the milk. Individuals consuming the cooked milk did not develop symptoms. The goat died within 24 hours after the milking related to the onset of symptoms. Material taken

from the udder post-mortem reproduced the symptoms in kittens. It was possible to immunize the kittens against this material by repeated injections of a filtrate from the homologous culture. The evidence suggests the possibility that if an enterotoxin was present it was thermolabile or that the lethal factor was responsible, at least in part, for the symptoms.

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Rationing Milk in New York City

Ernest L. Stebbins, M.D., Commissioner of Health of New York City, recently declared himself as being opposed to reductions in the current fluid milk consumption in New York City which may be contemplated under recent orders of the War Food Administration. Commissioner Stebbins stated that, in his opinion, cuts in current milk consumption should be made only as a last resort, and that no reduction should be made in the milk supply of schools and other institutions nor in the amount of milk sold at stores or through retail deliveries for home use.

If cuts in fluid milk consumption prove absolutely necessary, it was recommended that they should be made first through further reduction in uses for whipped cream, table cream, candy and frozen desserts. If still further reductions are absolutely imperative, a possible curtailment would be to take out from the fluid milk served to restaurants and soda fountains, even though this may affect the nutrition of some industrial workers.

Dr. Stebbins gave the following broad classifications of milk uses in New York City in order of relative importance:

	Number of Persons	Quarts of Fluid Milk Daily
1. Children in institutions (under 15 yrs. of age)	30,000	30,000
2. Penny milk and free lunch milk	150,000
3. Balance of child population (under 15 yrs.)	1,413,000	1,060,000
4. Adults in institutions	50,000	30,000
5. Other institutional use (cooking, staff use, etc.)	15,000
6. Balance of adult population	6,131,500	1,915,000
Total	7,624,500	3,200,000

Classification of Types of Milk Delivery Services in order of relative importance:

	Estimated Quarts Daily
1. To institutions	75,000
2. To schools (penny milk and free lunches)	150,000
3. To retail stores and direct to houses	2,545,000
4. To restaurants and soda fountains	430,000
Total	3,200,000