In the course of the next few days the inflammation spread down the thigh, chiefly on its anterior and medial aspects, as far as the knee. The skin was red and brawny, with a small necrotic patch in the mid-thigh. A fine crepitation in the region of the anterior-superior spine was palpable. On Nov. 19 Mr. W. K. Targett incised the thigh. "With a large aspirating needle, foul-smelling greyish-brown pus was obtained fairly superficially in the thigh (inner side). An incision in the same area opened a superficial 'space' containing gas and more pus. This was lined with greyish necrotic material. A drain was inserted. A second incision lower down was made. More gas and pus were found. The whole process was more like a generalized infiltration than a true abscess." Anti-gas-gangrene serum was given.

After the operation the patient's general condition improved a little, but locally there was an extension of the inflammation below the knee, with effusion in that joint and oedema of the leg. A black bulla was present in the thigh. Soon a necrotic area joined the two incisions. Subcutaneous crepitus could be felt in the upper and outer part of the thigh (Fig. 1).

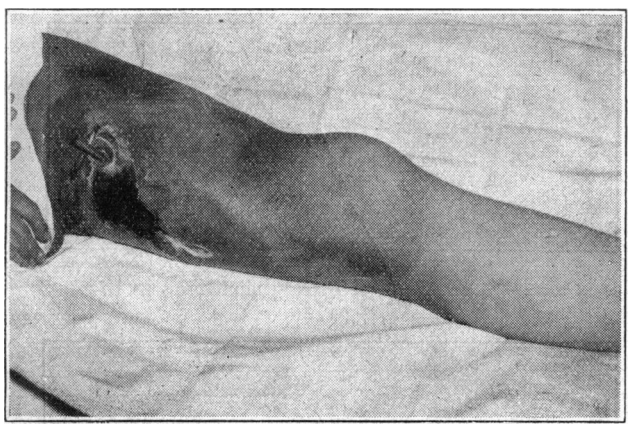

FIG. 1.—Wound in left thigh and extent of inflammation one week after operation

On Nov. 27 a fresh spontaneous sinus appeared near the knee posteriorly. The following day a morbilliform rash attributed to the sulphamezathine appeared on the right thigh and then spread generally. By Dec. 1 he looked worse; he became drowsy and dyspnoeic, and died the next day.

Investigations.—Nov. 15:—blood culture: growth of *Cl. welchii*; blood count: Hb, 90%; red cells, 5,140,000; white cells, 17,000 (polymorphs 81%). Nov. 17:—radiography: chest normal; spine and pelvis, no destructive bone changes seen; jaws edentulous. Nov. 19:—swab from wound: direct film—many Gram-positive and Gram-negative bacilli and cocci; aerobic culture gave a growth of non-haemolytic streptococci, coliform bacilli, and Gram-positive sporing bacilli. Anaerobic culture: no anaerobes isolated. Nov. 25:—radiography of left thigh: considerable gas present in the soft tissues, consistent with gas gangrene (Fig. 2).

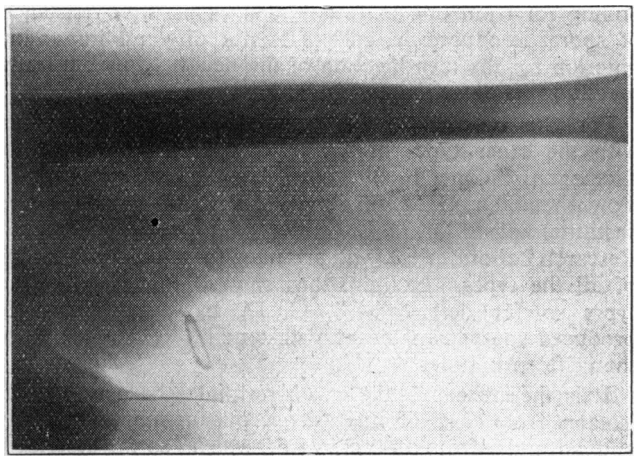

FIG. 2.—Radiograph of thigh showing gas in soft tissues

Post-mortem Examination.—A fungating carcinoma of the descending colon, 2 by 3 cm., was found just below the anterior-superior spine of the ilium. The carcinoma extended three-quarters of the way round the bowel and constricted the lumen but did not occlude it. There was a small stercoral ulcer 1 cm. proximal to the growth. The carcinoma was adherent to the psoas sheath and there was a track from the bowel into the psoas sheath, the contents of which were gangrenous. The superficial tissues over Poupart's ligament were also necrotic. Sections showed an anaplastic spheroidal-cell carcinoma of the colon with a marked trabecular formation. It had eroded through all layers of the gut wall. The muscle showed fragmentation with much oedema and hyaline degeneration. There were numerous clumps of *Cl. welchii* in the spleen. All swabs taken grew *Cl. welchii*.

Summary

An account is given of a patient with carcinoma of the colon presenting as a gas gangrene of the left thigh. The infection had spread from the intestine to the psoas muscle by means of a track connecting the carcinoma to the psoas sheath.

Similar examples of gas gangrene resulting from diseases of the bowel are quoted from the literature.

I am greatly indebted to Mr. W. K. Targett for the surgical treatment of the patient, and to Dr. J. Hewlett and Dr. G. Vincent for the pathological investigations.

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ENTERITIS NECROTICANS DUE TO CLOSTRIDIUM WELCHII TYPE F

BY

J. ZEISSLER, M.D.

AND

L. RASSFELD-STERNBERG

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In Hamburg on Oct. 8, 1946, Beckermann and Laas gave an account of a number of cases of a severe illness, often fatal, due to a necrotic inflammation of several areas of the intestine, especially in the jejunum. The onset was acute, with very severe pain and slight rigidity, mostly in the left lower abdomen, without obvious guarding. Vomiting and profuse diarrhoea resulted in general dehydration; within a few days extreme circulatory collapse occurred, with general cyanosis. Increased blood urea, low blood chloride, indicanaemia, and indicanuria were often demonstrable. The temperature was slightly raised (up to 38° C.), the blood picture showed a moderate leucocytosis with a marked shift to the left, and the blood sedimentation rate was increased. Surgical and post-mortem examination showed a diffuse sloughing enteritis of the jejunum, ileum, and colon, beginning in the terminal part of the duodenum or the first loop of the jejunum. The most severe lesions were tube-like areas of necrosed mucosa a foot or more in

length. The folds of the mucosa were rigid and thick: large necroses in the upper part of the jejunum were associated with great swelling of the whole inner wall of the intestine. Microscopically the necroses were simple, often extending through the submucosa to the muscle layer, and retained much of the original architecture of the intestine. No significant organisms were recovered from blood, stools, or urine, and no rational therapy could be suggested.

Jeckeln (1947, 1948), in Lübeck, described a similar apparently new disease, called "darmbrand," and suggested that it might be due to a toxin. At the same meeting Ruppert stated that the prognosis was uncertain and the mortality probably 40%. Siegmund (1948) states that the surface of the necrosed mucosa contains many bacteria, especially Gram-positive bacilli.

Heine (1947) refers to very acute cases, one patient dying within twelve hours of the appearance of symptoms. In these he found only redness and swelling of the mucosa, but no necrosis, and is somewhat doubtful that they are cases of enteritis necroticans. As, however, his cases showed oedema of the intestinal wall without leucocytic infiltration it is possible that they were due to bacterial toxins and might be regarded as hyperacute cases of the disease.

Schütz (1948) claimed that the organism responsible for darmbrand was an obligate anaerobe "very closely related to *B. welchii* type A, if not identical with it." Guinea-pigs injected subcutaneously or intramuscularly with cultures of his organisms in Tarozzi broth developed typical gas gangrene. Injection of liquid cultures into the duodenum of guinea-pigs led, especially if alkali was injected at the same time, to oedema of the duodenal wall, necrosis of the mucosa, and even perforations of the lower ileum and caecum. Schütz made no attempt to determine the type of *Cl. welchii* to which his organism belonged. This typing is, however, extremely important, as *Cl. welchii* type A is normally present in the ileum and colon, and may ascend into the upper part of the intestine if other pathological changes occur there. Moreover, the toxins produced by the different types of *Cl. welchii* require entirely different antitoxins to neutralize them, so that any rational therapy must to this extent depend on exact identification.

Lezius (1948), apparently impressed by Schütz's findings, treated his cases with a sulphonamide ("marbadal," a derivative of "marfanil") effective against *Cl. welchii* type A and also with a polyvalent gas-gangrene serum containing *Cl. welchii* α-antitoxin but no β-antitoxin.

Between September, 1946, and January, 1948, we received material from cases of enteritis necroticans from our colleagues (Aschenbrenner, Baniecki, Kuster, Laas, Loeweneck, and Rabl) for bacteriological examination: three loops of intestine removed by operation, specimens of intestine from eight post-mortem cases, and stool from a living patient in whom the diagnosis was well established clinically and by *x*-ray examination. From all these materials an organism closely resembling *Cl. welchii* was isolated.

Morphology

Its rods are rather thicker and usually longer than those of *Cl. welchii* type A, often growing into long filaments and forming clostridia and chains of spindles like *Cl. butyricum* and *Cl. gigas* (*Cl. oedematiens* type B) (Figs. 1–3). In surface colonies swollen forms and clostridia are to be found mainly in rough colonies, whereas the smooth colonies consist almost entirely of smooth single rods, somewhat thicker than those of *Cl. welchii* type A. The rough colonies may closely resemble those of *Cl. oedematiens*; this, however, causes no difficulty in identification, because *Cl. oedematiens* is peritrichous, whereas the organism isolated from cases of enteritis necroticans has no flagella. These morphological differences are, however, not consistent enough for use as discriminants, but the abundant development of rough colonies in surface culture and their marked difference

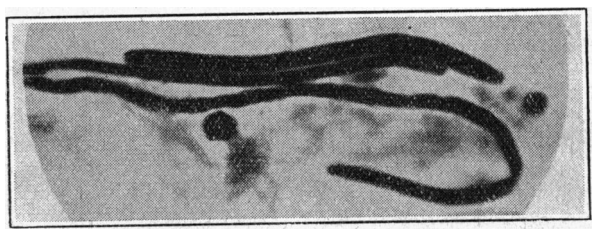

FIG. 1.—*Cl. welchii* type F, elongated forms (×1,500).

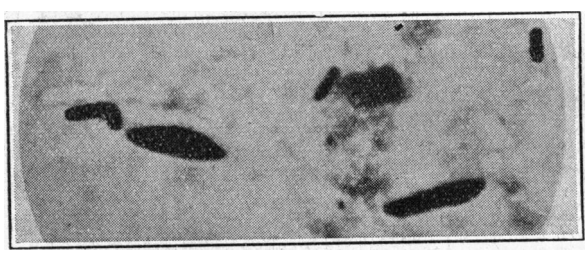

FIG. 2.—*Cl. welchii* type F, clostridial forms (×1,500).

FIG. 3.—*Cl. welchii* type F, chains of spindles (×1,500).

from the normal smooth colony of *Cl. welchii* type A are useful indications of the presence of the new organism (Figs. 4–7).

A decisive difference between the organism isolated from cases of enteritis necroticans and *Cl. welchii* type A is the high thermal resistance of its spores. Though in nature *Cl. welchii* type A forms rather resistant spores (surviving 100° C. up to 90 minutes), spores produced in the usual liver broth or brain pulp seldom resist boiling for more than ten minutes. In comparison all strains of the new organism grown on similar media produced spores resisting boiling for from one to four hours. This high resistance of spores produced in culture is not only an important criterion for the identification of the new bacillus but leads readily to its detection and isolation.

For the opportunity of comparing the new bacillus with the other types of *Cl. welchii* we are indebted to Lieutenant-Colonel F. Buckland, Lieutenant-Colonel R. L. Townshend, Dr. G. M. Findlay, and Dr. S. T. Cowan (Lister Institute) and to Dr. C. L. Oakley (Wellcome Physiological Research Laboratories), who arranged for a supply of strains of all the types. Examinations showed that none of the types so far described—B, C, D, E (Bosworth, 1943) produced spores capable of withstanding boiling for more than fifteen minutes.

It is therefore possible to differentiate the new bacillus isolated from cases of enteritis necroticans morphologically and culturally from all types of *Cl. welchii* so far described, and we therefore propose for it the name *Cl. welchii* type F.

All cultures used in this investigation were separated from other organisms by repeated boiling of sporing cultures and were derived from single cells obtained by micro-manipulation.

Toxicology and Pathogenicity

Toxicology.—As no suitable sera were available in Germany for the discrimination of the types of *Cl. welchii*, eight strains of the new organism were sent to Dr. C. L. Oakley, who reported that they produced traces of *Cl. welchii* α-toxin, considerable quantities of β-toxin, and some γ-toxin. No δ-, ε-, θ, κ-, or λ-toxin was produced. Oakley's findings that the main toxin is β shows that treatment with *Cl. welchii* type A serum would be of no value, as this serum contains no β-antitoxin, and that for any hope of success in treatment serum containing *Cl. welchii* β-antitoxin would be essential.

Pathogenicity.—Intramuscular injection of cultures of *Cl. welchii* type F into guinea-pigs leads to the production of a glassy gelatinous or blood-stained oedema similar to that produced by injection of *Cl. welchii* type B. Death occurs rapidly—something in our experience never seen in other anaerobic infections. Intravenous injection of culture usually led to death in a few minutes. Though feeding *Cl. welchii* type F cultures to guinea-pigs did not cause enteritis, injection of 5 ml. of a one-day-old culture of *Cl. welchii* type F into the lumen of the guinea-pig's intestine led to the development of an enteritis histologically and bacteriologically very similar to that observed in enteritis necroticans in the first days of illness (Professor Laas) and very similar to the enteritis and localized ulceration long known to occur in lambs and foals infected with the lamb-dysentery bacillus, which like *Cl. welchii* type F produces β-toxin. It seems probable, therefore, that the damage to the intestine in enteritis necroticans is due to the β-toxin of *Cl. welchii* type F.

Sensitivity.—*In vitro* tests showed that *Cl. welchii* type F is inhibited by 10 units but not by 1 unit of penicillin per ml.; that it fails to grow in "badional" (sulphanilylthiourea) 1 in 156; that it is remarkably sensitive to "marfanil" (sulphamylon, *U.S.*), "marbadal" (a derivative of marfanil), and "supronal" (a mixture of sulphamerazine and marbadal), which all inhibit its growth at 1 in 10,000; and that sulphadiazine does not affect its growth at all.

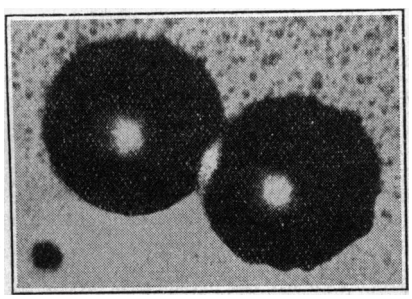

FIG. 4.—*Cl. welchii* type F, one rough, one smooth colony (×25).

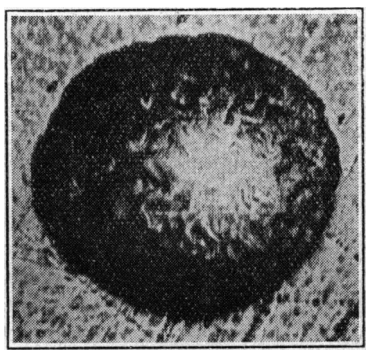

FIG. 5.—*Cl. welchii* type F, mature smooth colony (×25).

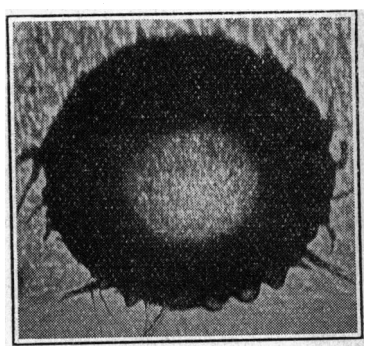

FIG. 6.—*Cl. welchii* type F, rough colony, with characteristic thornlike outgrowths (×25).

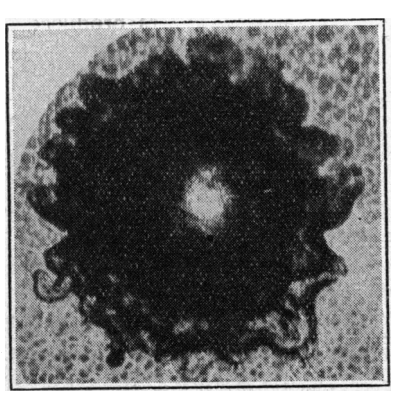

FIG. 7.—*Cl. welchii* type F, rough colony with wavy outgrowths (resembling *Cl. oedematiens* type A) (×25).

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THE TOXINS OF CL. WELCHII TYPE F

BY

C. L. OAKLEY, M.D., B.Sc.

Eight cultures of a type of *Cl. welchii* isolated by Professor Zeissler from cases of enteritis necroticans have so far been examined. They were subcultured into meat broth within 24 hours of arrival, and after appropriate subculture were tested for toxin production by growing them for times varying from 5 to 16 hours in 5-litre quantities of meat broth plus concentrated papain digest of horse meat with a small amount of meat particles; 0.5% sterile glucose was added immediately before inoculation. The cultures were passed through sterile paper pulps to clarify them and finally sterilized by filtration through Seitz filters. In some instances filtrates were precipitated by saturation with ammonium sulphate and the cake so produced dried.

Examination for Toxins (cf. Oakley, 1943)

Lecithovitellin Tests (Macfarlane, Oakley, and Anderson, 1941).—Filtrates from all strains except Z6 and Z8 produced opalescence on incubation for one hour at 37° C. with egg-yolk emulsion; this opalescence could be inhibited by adding to the filtrate *Cl. welchii* α-antitoxin free from other known antitoxins, but was never marked enough to serve as indicator in a full serological investigation.

Haemolytic Tests.—Filtrates from all strains except Z6 and Z8 produced slight haemolysis of sheep red cells. This haemolysis was inhibited by *Cl. welchii* α-antitoxin and, like the opalescence produced in egg-yolk emulsions, is probably due to *Cl. welchii* α-toxin.

Necrotizing Tests.—All filtrates except those from Z6 and Z8 produced a necrotic reaction on intracutaneous injection into guinea-pigs. This reaction is readily inhibited by sera containing *Cl. welchii* β-antitoxin, and serum values can be determined against a standard, using the production of a small area of necrosis (approximately 2 by 2 mm.) as standard indicating effect. Table I shows that sera

TABLE I.—*Serum Values against Cl. welchii Type F Filtrates in Necrotizing Tests to Show Presence of β-toxin*

Serum	Serum Value Against Filtrate from Strain			β-antitoxin Value
	Z2 (NX.597)	Z4 (NX.601)	Z5 (NX.602)	
RR.2364 ..	1,000	1,000	1,000	1,000
RR.2452 ..	1,150	1,200	1,150	1,100
RR.5636 ..	380	450	425	400
RR.6160 ..	400	450	400	400
RR.4547 ..	1,100	1,150	1,100	1,200
RR.4642 ..	1,150	1,150	1,200	1,000
RR.4831 ..	2,000	2,200	1,900	2,100
RR.5993 ..	2,200	2,300	2,400	2,700
RR.4779 ..	2,000	2,200	1,900	2,500
EX.731 ..	95	110	110	100
R.3503 ..	650	675	700	700
R.8819 ..	700	750	800	800
RR.3518 ..	1,700	1,900	1,850	1,900
R.3547 ..	1,850	1,850	1,500	1,500
R.7365 ..	1,350	1,650	1,300	1,300

neutralize the necrotizing activity of these filtrates in proportion to this β-antitoxin content: the necrotic lesion is therefore probably due to β-toxin.

Lethal Tests.—All filtrates (except those from Z6 and Z8) produced rapid death in mice on intravenous injection. The lethal property is completely neutralized by sera containing *Cl. welchii* β-antitoxin, but serum-value tests show that both β- and γ-toxins are present in the filtrates. Thus the majority of sera examined give the same value in lethal tests as in necrotizing tests (Table II), and confirm the presence of β-toxin; a few, however, though giving the β value in necrotizing tests, give a much lower value in lethal tests, suggesting the presence of γ-toxin in the filtrates. No evidence could be obtained in either lethal or necrotizing tests of the presence of ε-toxin.

TABLE II.—*Serum Values against Cl. welchii Type F Filtrates in Lethal Tests to Show Presence of β- and γ-toxins*

Serum	Serum Value Against Filtrate from Strain			β-antitoxin Value
	Z2 (NX.597)	Z4 (NX.601)	Z5 (NX.602)	
RR.2364 ..	1,000	1,000	1,000	1,000
RR.2452 ..	1,100	1,100	1,100	1,100
RR.5636 ..	330	360	360	400
RR.6160 ..	360	400	380	400
RR.4547 ..	1,000	1,100	1,150	1,200
RR.4642 ..	950	1,000	950	1,000
RR.4831 ..	2,300	2,100	2,300	2,100
RR.5993 ..	2,500	2,800	2,800	2,700
RR.4779 ..	2,500	2,200	2,300	2,500
EX.731 ..	85	90	95	100
R.3503 ..	660	750	670	700
R.8819 ..	850	850	800	800
RR.3518 ..	1,900	2,300	2,200	1,900
R.3547 ..	380	550	475	1,500
R.7365 ..	850	650	675	1,350

Tests Using Fresh Guinea-pig Muscle, Collagen-paper, and Azocoll.—No κ- or λ-toxin (Oakley, Warrack, and Warren, unpublished) could be detected in any filtrate by use of these indicators.

Table III shows the toxins so far known to be produced by the various types of *Cl. welchii*. It is clear that the

TABLE III.—*Toxins Produced by Various Types of Cl. welchii*

Type	Toxins										Origin
	α	β	γ	δ	ε	η	θ	ι	κ	λ	
Cl. welchii											
Type A ..	+++	−	−	−	−	(+)	+	−	+	−	Gas gangrene
,, B ..	+	+++	+	±	+	−	+	−	−	+	Lamb dysentery
,, C ..	++	+++	+	++	−	−	+	−	+	−	Struck
,, D ..	+	−	−	−	++	−	+	−	±	?	Enterotoxaemia
,, E ..	+	−	−	−	−	−	+	+	+	+	? Pathogenic
,, F ..	+	+++	+	−	−	−	−	−	−	−	Enteritis necroticans

present organism does not agree exactly with any type so far described. By the classical methods of Wilsdon (1931, 1932–3) it would be diagnosed as type C, but its failure to produce κ or δ, or to produce much α, or to ferment glycerol to any marked extent is good evidence against this view. It most closely resembles strains of *Cl. welchii* type B that have lost their power to produce ε-toxin; but in view of the high consistency in the strains derived from enteritis necroticans and Zeissler's observation (confirmed in these laboratories) that culture spores of these organisms are much more resistant to heat than those of *Cl. welchii* type B, I consider it reasonable to regard it as a new type—*Cl. welchii* type F.

Antitoxins in Convalescent Sera.—Of six sera examined from persons convalescent from clinical enteritis necroticans, three contained about 0.2 unit of *Cl. welchii* β-antitoxin per ml.; the others contained less than this amount. No *Cl. welchii* α- or ε-antitoxin could be demonstrated.

I should like to express my thanks to Miss H. E. Ross and to Mr. H. Proom for subculturing these materials and for supplying me with much useful information; and to thank Miss Ross for providing all the culture filtrates.

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RECOVERY OF CL. WELCHII TYPE F FROM PRESERVED CULTURES

BY

C. DIECKMANN, M.D.

(From the Bacteriological Institute, General Hospital, Hamburg-Altona)

Sixty-three strains identified as *Cl. welchii*, preserved in Professor Zeissler's collection of anaerobes, were inoculated into liver broth; from the growth five test-tubes containing brain pulp were inoculated. After two days' incubation in Zeissler's anaerobic jar at 37° C. and three days' at room temperature the test-tubes were boiled in Koch's steam-pot at 100° C. for 5, 60, 120, 180, and 240 minutes and cooled immediately in cold water. From the material so treated 0.5 ml. was transferred to test-tubes containing liver broth and incubated in the anaerobic jar for two days at 37° C.

Of the 63 strains tested only two survived boiling for as long as 5 minutes—one survived 120 and the other 180 minutes. Both had the characters of *Cl. welchii* type F. Both were recovered from war wounds of German soldiers on the Russian front in 1943; one (Ru 62) was the only pathogenic organism recovered; the other (Ru 72) was associated with *Cl. sordellii, Cl. oedematiens maligni gracilis, Cl. tetani*, and *Cl. putrificus verrucosus*.

ORIGIN OF CL. WELCHII TYPE F INFECTION

BY

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(From the Bacteriological Institute, General Hospital, Hamburg-Altona)

The following case throws some light on the origin of *Cl. welchii* type F infection in man.

Case Report

A man aged 71, never ill previously but with a rather poor digestion for the last few years, ate with some friends a meal consisting of tinned rabbit, tinned fat giblets, and green cabbage. A few hours later he fell ill with abdominal discomfort and frequent vomiting; later he developed abdominal pain, and during the night passed about twenty watery stools. Increasing exhaustion and low blood pressure developed, and he was admitted to hospital next morning.

His notes state that he was a well-developed rather fat man, apathetic, weak-looking, pale, with some cyanosis of his extremities; his pulse was scarcely perceptible, his blood pressure very low. His abdomen was slightly distended; he felt no pain, but was tender in the right epigastrium. His temperature was 39° C. His blood picture showed a polymorphonuclear leucocytosis with a marked shift to the left; the blood sedimentation rate was increased. Electrocardiography revealed evidence of recent cardiac infarction.

Passage of frequent blood-stained watery stools led to further dehydration and impairment of the circulation; restoratory measures and treatment with "resulfon" had no effect; surgical treatment was considered hopeless. The patient died about 50 hours after the onset of the symptoms.

At necropsy the clinical diagnosis of enteritis necroticans was confirmed; there was a necrotic inflammation of the jejunum, most marked in its upper part and decreasing in severity along its length. Several smaller ulcers were present in the ileum and rectum.

Two persons who shared the meal with the patient fell ill soon after it with slight sickness, and one passed a single watery stool. Both recovered in twenty-four hours without calling in a doctor.

Bacteriological Examination.—Full bacteriological examinations were made of the remnants of food left from the meal, of stools from the patient and from those who had shared the meal with him, and of the contents of a loop of the patient's intestine obtained post mortem. The green cabbage and stool from one of the friends yielded no significant pathogen; from all the other samples *Cl. welchii* type F was readily isolated by the following technique.

(1) *Stool.*—Samples of stool the size of a pea were placed in test-tubes containing sterile broth and boiled at 100° C. in in a steam-pot for 60 minutes. This acted as a first screen for selecting organisms with resistant spores. About one-fifth of the boiled material was inoculated with liver broth and both tubes were incubated in the anaerobic jar for 16 hours at 37° C. If no growth occurred in the liver broth it was reinoculated from the broth tube.

(2) *Other Materials.*—These were inoculated into 100–500 ml. of brain pulp and incubated for three to five days. From this material 0.5 ml. was inoculated into fresh brain pulp and the five tubes so inoculated were boiled for 60, 90, 120, 180, and 240 minutes.

Then by repeated subculture from liquid to solid media, and from solid to liquid, with frequent boiling of sporing cultures, pure cultures were obtained and tested for action on gelatin, sugars, and alcohols, and for pathogenicity to guinea-pigs.

Comment

The food used in the meal had been prepared from home-bred rabbits butchered about three weeks before and tinned immediately. The tins were closed and boiled for two hours in a water bath. When the tins were opened and the meat prepared for food three weeks later it appeared wholesome in appearance and odour. Notwithstanding this, three persons who ate it sickened; one of these died, and from the stools of two of them and from the meat *Cl. welchii* type F was recovered. It is clear that the usual method of sterilizing meat by boiling for two hours will not suffice if it is contaminated with this organism.

I have to thank Dr. Aschenbrenner for the clinical notes and Dr. Baniecki for the post-mortem record.

ON THE OCCURRENCE OF CL. WELCHII TYPE F IN NORMAL STOOLS

BY

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In an investigation on the occurrence of *Cl. welchii* type F in the normal intestine, 108 stools derived from persons not suffering from enteritis necroticans were examined for the presence of this organism. The results are shown in Tables IV and V.

As the patients were a reasonable cross-section of the inhabitants of Hamburg, I feel that the figures show that about one-sixth of the normal persons in Hamburg during the winter of 1947–8 carried *Cl. welchii* type F in their stools. The strains recovered are, however, much less pathogenic for animals than those isolated from cases of enteritis necroticans. Most of the guinea-pigs who received injections into the thigh of pure cultures of the organisms from normal stools would have recovered without treatment had they not been killed on the second or fourth day after injection.

TABLE IV.—*Proportion of Cases in which Cl. welchii Type F was Recovered from Stools, Arranged According to Age and Sex of the Patients*

	Men				Women			
Age:	0–14	15–50	>50	Total	0–14	15–50	>50	Total
No. of samples ..	13	27	10	50	14	34	10	58
Cl. welchii type F:								
Present	2	3	2	7	2	9	1	12
Absent	11	24	8	43	12	25	9	46

TABLE V.—*Results Arranged According to the Origin of Stools Yielding Cl. welchii Type F on Culture*

Cl. welchii Type F	Origin of Material					
	Cases of Typhoid and Paratyphoid Fever	Cases of Diarrhoea and Dyspepsia Suspected of Typhoid, Paratyphoid, or Dysentery	Cases of Surgical and Skin Diseases	Cases of Internal Disease	Personnel of Camp Kitchen	Total
Positive ..	2	2	3	9	3	19
Negative ..	11	11	18	47	2	89
Total ..	13	13	21	56	5	108

The pathological changes produced in the injected animals (glassy gelatinous oedema of the subcutaneous tissues) were qualitatively similar to those produced by the more virulent strains but far less severe.

Further research will be necessary before it is possible to show whether carriers are of any importance in the epidemiology of enteritis necroticans.