A SUMMARY OF 103 AUTOPSIES ON LEPROSY PATIENTS ON THE ISTHMUS OF PANAMA

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INTRODUCTION

Detailed reports of autopsy findings in lepers are scarce. An analysis of the autopsy protocols at the Board of Health Laboratory was undertaken to obtain information as to the causes of death and the pathologic findings in lepers on the Isthmus of Panama. A discussion of the clinical and sociological aspects of leprosy on the Isthmus of Panama has been provided by Hurwitz and Anderson (1).

The Board of Health Laboratory is located on the grounds and is operated in connection with Gorgas Hospital, Ancon, Canal Zone. In its files from October, 1904, to March, 1941, are records of autopsies on 103 lepers, practically all of whom died at the Palo Seco Leper Colony. During that period 12,690 autopsies were performed; the autopsy percentage of lepers was 0.8 per cent. The number of autopsies on lepers each year varied from none to eight. Since the establishment of leprosy control by the Canal Zone authorities in 1905, lepers totaling 180 are known to have died. One hundred and three or 57 per cent of these lepers were examined postmortem at the laboratory. All the autopsies were complete and, with only a few exceptions, included microscopic studies of sections and smears. The autopsies were performed by various pathologists who have been on duty at the Board of Health Laboratory: Lewis B. Bates, Herbert C. Clark, Virgil H. Cornell, Paul E. McNebb, Raymond O. Dart, Elbert DeCoursey, Hugh W. Mahon, Loren D. Moore, Hugh R. Gilmore, Jr., and B. H. Kean.

In practically all the protocols there are brief summaries of the clinical histories. From these digests, the clinical data were obtained.

The series included 79 males and 24 females. (On the Isthmus of Panama the male population, especially amongst Negroes, is much higher than the female population because thousands of laborers were imported during the construction period of the Panama Canal.) Of the 103 lepers, 59 were Negroes, practically all male West Indians, 33 Panamanians, 4 Chinese, and 7 others. Forty-six cases were found in the cities of Panama and Colon; the provinces of Bocas del Toro and Los Santos contributed 11 and 10, respectively; the remainder were from scattered localities in the

Republic of Panama and the Canal Zone. Most of the lepers found in the cities of Panama and Colon were Negroes who may have acquired the disease in their native islands, Jamaica, Barbados, etc., before coming to Panama.

The average age of death for males was 48.2 years, for females, 43.6 years, and for the entire group, 47.1 years. The average age of death from all causes in Panama is not known. The average age of recorded onset was 36.7 years, and the average age at the time of hospitalization was 38.7 years. The first symptoms most frequently noted were nodules of the ears and nose, and ulcers of the feet. During their stay in the Palo Seco Leper Colony practically all of the patients received treatment with chaulmoogra oil and hydnocarpic acid preparations.

TABLE I. *Lesions of the skin (type and location)*

	Nodules	Ulcers	Pigment changes	Scars	"Thick" skin	Other lesions
Scalp	1	1			1	
Forehead	5	2			1	
Ears	30	13			9	
Nose	9	10	1	1	6	
Lips	2	5				
Cheeks and face	17	5	5	2		1
Neck and shoulders	3	2	2			1
Chest and abdomen	5	5	4	2		2
Back	3	6	1	3		3
Sacrum		10	1			
Penis and scrotum	1	1				
Arms and elbows	9	7	7		1	3
Forearms	8	8	4	4		
Hands and fingers	13	20		1		3
Thighs	7	6	2	1		
Legs and ankles	5	19	7	6		1
Feet and toes	8	29	2	3	1	1
Generalized	7	3	15	3	1	3

PATHOLOGIC FINDINGS*

Skin: The positive autopsy findings are summarized in Table I.

Eyebrows and eyelashes:

Eyebrows:

Missing	17
Scant	14
Total	31

* The numbers recorded following the names of diseases, lesions or anatomic locations in all the data under *Pathologic Findings* refer to the number of patients exhibiting the change at autopsy.

Eyelashes:		
	Missing	12
	Scant	10
	Total	22

Eyes: Leprous iritis 1; leprous keratitis 1; conjunctivitis 5; pterygia 2; ulcers of cornea 3; keratitis 2; cataracts 5; panophthalmitis 2; pthisis bulbi 2.

Enucleation, with sectioning of the eyes for histopathologic study, was not done, hence these recorded findings are of little significance.

Central nervous system: Tuberculous meningitis 2; chronic fibrous leptomeningitis 6; pachymeningitis 2; hemorrhages of brain 6; encephalomalacia 6; atrophy of brain 6; syphilitic encephalitis 2; tumors 2; cyst 1; hydrocephalus 1; congestion or edema 5; arteriosclerosis 4.

No evidence of leprosy of the central nervous system was found.

Peripheral nerves: (positive for leprosy) Ulnar 42; median 4; external peroneal 11; posterior tibial 2.

No systematic routine for the examination of the peripheral nerves was followed. Hence the figures represent the *least* number of nerves affected and give no indication of the actual number of nerves which would have shown lesions if examined. In five instances the ulnar nerve was examined and found to be unaffected.

Upper respiratory system:

Septum:	Leprosy	38
Turbinates:	Leprosy	4
Pharynx:	Leprosy	6
	Tuberculosis	1
Tonsils:	Leprosy	1
	Tuberculosis	2
Larynx:	Leprosy	3
	Tuberculosis	8
	Undetermined	1
Trachea:	Tuberculosis	2
Miscellaneous lesions		6

The impression is gathered from these observations that leprosy tends to affect the "outer" or upper portion of the upper respiratory system, whereas tuberculosis plays a more important role in the "lower" portion of the upper respiratory system.

Pleura: Adhesions 52; effusions 26; tuberculous pleurisy 2; acute pleuritis 1.

Lungs: Leprosy 1; tuberculosis (including miliary) 30; bronchopneumonia 13; lobar pneumonia 2; abscesses 3; infarcts 4; atelectasis 4; emphysema 8; fibrosis 1; edema or congestion or both 33.

The possibility exists that the solitary case of leprosy of the lungs may have been incorrectly diagnosed.

Heart: Pericardial effusions 20; pericarditis (all types) 6; cardiac hypertrophy 19; cardiac dilatation 14; cardiac atrophy 16; myocardial fibrosis 16; coronary sclerosis 7; myocardial infarction 2; fatty degeneration 2; mural thrombosis 4; chronic sclerotic aortic valvulitis, etiology not specified, 9; syphilitic aortic valvulitis 1; chronic fibrous mitral valvulitis, etiology not specified; 4; acute vegetative mitral valvulitis 2.

The absence of leprous lesions and the infrequency of syphilitic stigmata appear noteworthy. The nature of the fibrosis of the aortic and mitral valves is not clear. Rheumatic fever is rare in Panama (2) and was not incriminated as the etiologic agent in these cases.

Systemic circulation: Atherosclerosis of aorta 20; general arteriosclerosis 16; syphilitic aortitis 8; syphilitic aneurysm of aorta 1; hypoplasia of aorta 1; dilatation of aorta 1; thrombosis of large artery 5.

Peritoneum: General peritonitis 8; localized peritonitis 2; tuberculous peritonitis 3; peritoneal effusions 11; peritoneal adhesions 11.

Much of the peritonitis was secondary to nephritis or perforated peptic ulcer.

Liver and gallbladder: Leprosy 9; tuberculosis (all types) 10; portal cirrhosis 7; cirrhosis (type not specified) 6; cholelithiasis 11; fatty degeneration 8; hemangiomas 4; syphilis 1; malarial pigment 9; atrophy 3; chronic passive congestion 14; miscellaneous lesions 9.

Histologic findings considered characteristic of leprosy were found in only 9 per cent. The incidence of cirrhosis (13 per cent) is very much higher than in routine autopsy material here (2). The presence of cholelithiasis in 11 per cent of the subjects was surprising. In his series of 1,500 autopsies at the Board of Health Laboratory, Clark (3) found that the incidence of cholelithiasis was 2.6 per cent. Possibly the lipemia which has been noted (4) in lepers was associated with the high incidence of gallstones.

Spleen: Leprosy 9; tuberculosis 9; fibrosis 16; splenomegaly 8; "septic" spleen 4; septic infarcts 2; infarcts 4; amyloidosis 2; atrophy 2; perisplenitis 7; malarial pigment 13.

Pancreas: Miliary tuberculosis 7; acute hemorrhagic pancreatitis 1; suppurative pancreatitis 1; fibrosis 1; chronic pancreatitis 1; metastatic carcinoma 1; atrophy 1.

Adrenals: Leprosy 1; tuberculosis 1; amyloidosis 1; hyperplasia 1; infarcts 1; atrophy 2; metastatic tumor 1; periadrenalitis 1.

Kidneys and bladder: Acute glomerulonephritis 4; chronic glomerulonephritis 8; acute nephritis (type unspecified) 5; chronic nephritis (type unspecified) 17; arteriolonephrosclerosis 4; nephrosclerosis 13; tuberculosis (all types) 7; amyloidosis 4; cysts 3;

calculi 1; infarcts (septic) 1; pyelitis 3; cystitis 8; tumor of bladder 1.

The changes in the concepts and nomenclature of nephritis which have occurred during the past decade make interpretation of the statistics on kidney lesions difficult—and somewhat dangerous. The large number of cases of "chronic nephritis" include, undoubtedly, instances of chronic pyelonephritis, glomerulonephritis and arteriolonephrosclerosis.

Both acute and chronic glomerulonephritis are rare in routine autopsy material on the Isthmus of Panama (2). A relationship between leprosy or its complications and glomerulonephritis is, therefore, strongly suggested by the high incidence of glomerulonephritis in lepers.

According to Fishberg (5), "Acute glomerulonephritis is a manifestation of an infection in one part or another of the body. While cold and other factors often play an important part as predisposing causes, recent investigations have shown more and more clearly that the primary and essential cause is infection." In few diseases are secondary infectious foci present in such great numbers and for such long periods as in leprosy.

Penis: Leprosy 1; chancre 1; ulcers 3; peri-urethritis 1; stricture of urethra 1.

Testis: Leprosy 5; fibrosis 23; atrophy 5; chronic orchitis 2; undescended testes 2; abscess 1; gumma 1; hydroceles 2.

The lesions of "fibrosis," "atrophy," and "chronic orchitis" probably belonged in the category of healed or healing leprosy.

Epididymis: Leprosy 3; tuberculosis 1; nonspecific epididymitis 1; fibrosis 2.

Prostate: Leprosy 1; prostatitis 4; hypertrophy 11.

Nodes: Positive for leprosy: general 3; mediastinal 4; peritoneal 1; inguinal 2; iliac 1; cervical 1; total 12.

Positive for tuberculosis: mediastinal 14; abdominal 3; cervical 1. Total 18.

Positive for non-specific lymphadenitis: general 3; mediastinal 1; retroperitoneal 1; pelvic 1; abdominal 3; inguinal 2. Total 11.

If all the lymph nodes had been examined routinely for leprosy, the incidence of lesions would unquestionably have been much higher.

Digestive tract: Leprous gingivitis 1; papule of mouth 1; leukoplakia of tongue 1; carcinoma of esophagus 1; chronic gastritis 1; carcinoma of stomach 1; peptic ulcer of stomach 3; unperforated duodenal ulcer 1; perforated duodenal ulcer 4; gastroduodenitis 1; tuberculosis of small intestine 6; septic abscess of small intestine 1; ulcers of ileum 3; appendicitis 2; appendectomy 1; enterocolitis 2; melanosis coli 2; polyposis coli 2; ulcer of colon 1; submucous

lipoma 1; diverticuli 1; diverticulitis 1; rectal polyp 1; tuberculous proctitis 1; hemorrhoids 1; anal fistula 1; metastasis to intestine from carcinoma of breast 1.

Except for the gingivitis, no lesions of leprosy were found in the enteron. The high incidence of tuberculosis merely reflects the frequency of that disease in all organs. No explanation is available for the high percentage (8 per cent) of gastric and duodenal ulcers.

Joints and muscles: Contractures of hands 16, fingers 11, leg 3, feet 4, toes 2; arthritis, all types, 7; atrophy of muscles 4; miscellaneous lesions 7.

Osseous system: Amputations of one toe 12, one or more fingers 14, leg 9, foot 1; absorptions, fingers 19, toes 18, feet 3; gangrene of toe 2; miscellaneous lesions 7.

Subcutaneous tissues: Edema 15; lipomas 2; obesity 2.

Wassermann test of blood: Total examined 80; positive, 26; doubtful 4; negative 50.

Many of the patients had received antiluetic treatment during their stay in Palo Seco Leper Colony. Hence the incidence of positive serology in life was probably greater than 26 in 80 or 32.5 per cent. During the year 1940, the blood of 14,630 Negroes and mestizo individuals was examined at the Board of Health Laboratory (6); 14.4 per cent of these had positive Wassermann tests. In the charity wards of Santo Tomas Hospital, Panama, R. de P., are treated patients which represent, more closely, the same stratum of society as that from which the lepers came. The incidence of positive serology in the blood specimens examined at the laboratory of Santo Tomas Hospital during the year 1941 was 15 per cent (7). During the years 1924-1933, however, when 110,935 specimens were examined, 22 per cent were positive; in some years, as in 1924 and 1926, as many as 30 per cent were positive (7).

Feces: Uncinaria 8; *Strongyloides stercoralis* 9; *Trichuris trichiura* 3; *Enterobius vermicularis* 1; *Endameba coli* 1.

Practically all of the patients had been treated for intestinal parasites during their stay in the colony.

Miscellaneous: Numerous miscellaneous lesions were found, but these did not appear significant enough for listing.

Causes of Death

Causes of death: That lepers generally do not die of leprosy is widely recognized. A study of the official causes of death in lepers as recorded in Table 2 would lead to a false impression, since with few exceptions leprosy was listed as the cause of death even when the patient obviously died from the effects of a complicating disease. This practice, which deviates somewhat from the Manual of the International List of Causes of Death and Joint Cases of Death (8), was followed in order to keep the records on lepers uniform and

readily available for study. The final causes of death were often listed as the contributory causes.

In Table 3 the restrictions of this method of classification have been disregarded and the final causes of death as determined by clinical history and autopsy findings are recorded. As has been noted by others (9, 10), tuberculosis and nephritis predominate.

Of the 24 patients who died of tuberculosis, 18 died of pulmonary tuberculosis, 4 of miliary tuberculosis, 1 of tuberculous meningitis, and 1 of tuberculous enteritis.

Of the deaths due to nephritis, 10 were chronic glomerulonephritis, 4 acute glomerulonephritis, 6 chronic nephritis, type unspecified but including pyelonephritis, and 2 arteriolonephrosclerosis.

Of the deaths due to heart disease, there were 3 instances of bacterial endocarditis, 2 of chronic valvular disease, 1 of syphilitic valvulitis, 2 of cardiac hypertrophy and dilation, and 1 of coronary sclerosis with occlusion.

TABLE 2. *Official causes of death*

Leprosy	82
Pulmonary tuberculosis	6
Chronic nephritis	2
Pancreatitis	2
Sclerotic endocarditis	2
Duodenal ulcer	1
Cancer	1
Osteomyelitis	1
Syphilitic heart disease	1
Pleurisy	1
Malaria (estivo-autumnal)	1
Suicide	1
Enterocolitis	1
Ischiorectal abscess	1
Total	103

TABLE 3. *Interpreted causes of death*

Tuberculosis	24
Nephritis	22
Leprosy	15
Heart Disease	10
Cancer	4
Pneumonia	3
Duodenal ulcer	3
Malaria	3
Appendicitis	2
Pancreatitis	2
Arteriosclerotic gangrene of foot	2
Cerebral hemorrhage	2

Osteomyelitis, phagedenic ulcer of face, encephalomalacia, ischiorectal abscess, pulmonary abscess, portal cirrhosis, pleurisy, enterocolitis, general arteriosclerosis, suicide, unknown (one of each)	11
Total	103

Summary

1. Of 103 autopsies performed on lepers at the Board of Health Laboratory, Gorgas Hospital, Ancon, Canal Zone, between the years 1904-1941, 79 were on males and 24 on females. Although half of the patients were found in the cities of Panama and Colon, the evidence suggests that many cases were imported from Jamaica and Barbados. Foci of leprosy probably exist in the provinces of Los Santos and Bocas del Toro.

2. The average age of recorded onset of leprosy was 36.7 years; the average age of death was 47.1. The most frequent "first symptoms" were nodules of the face and ulcers of the feet.

3. The pathologic changes in all the organs were listed systematically. Some of the findings worthy of comment are:

a) Leprosy affected the nasopharynx or upper or outer portion of the upper respiratory system, whereas tuberculosis affected the larynx and trachea or lower portion of the upper respiratory system.

b) A high incidence of cirrhosis of the liver.

c) A high incidence of gallstones.

d) A high incidence of nephritis, especially glomerulonephritis.

4. The final causes of death were, in the order of numerical importance; tuberculosis, nephritis, leprosy and heart disease.

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