LEPTOSPIROSIS IN SOUTH-EAST SCOTLAND

A REPORT OF TWENTY SEROLOGICALLY CONFIRMED CASES

BY

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In the period 1947–50, 465 cases of Weil's disease were reported in England, Wales, and Northern Ireland, and 70 human cases of *Leptospira canicola* fever in England and Wales (Broom, 1951). An analysis of 418 of the cases of Weil's disease showed that 31% occurred in farm workers. Bathing and accidental immersion accounted for 19%, and 31% were in persons of "miscellaneous" occupations. Sewer workers, coal-miners, food-handlers, fish workers, and workers in water made up the remaining 19%. The mortality rate was 15%, which compares with the rate of 22% recorded for the period 1940–46 by Broom and Alston (1948).

In Scotland, reports of leptospirosis have on the whole been connected with definite occupations. Thus Weil's disease was reported in coal-miners by Gulland and Buchanan (1924), by Jenkins and Sharp (1946), and by Sharp (1953). The total number of cases among coal-miners notified from 1924 to 1951 and reported by the latter two workers was 101, of which 29 died. The districts mainly concerned were East Lothian, Midlothian, Fife, and the Clyde Valley, this last supplying more than half the total cases.

Smith (1949) has reviewed the incidence of Weil's disease in north-east Scotland, including Orkney and Shetland, from 1934 to 1948 and in his series described 183 cases occurring in fish workers in Aberdeen (including 98 reported by Davidson and Smith in 1939).

In the Glasgow fishmarket, six sporadic cases of Weil's disease, occurring during the period 1944–50, were reported by Goudie, Weir, and Wilson (1952), together with a description of working conditions and their relation to leptospiral infection.

Sewer workers have provided relatively more published cases of leptospirosis in Scotland than in England. Thus, following Stuart's investigation (1938) into Weil's disease in Glasgow sewermen, Bell (1953) reported that a total to date of 28 cases had occurred among these workers, 23 of them since 1935.

Though Broom showed that farm workers supply the bulk of cases in England and Wales, no published record seems to be available so far of Weil's disease in Scottish farm workers. Meat-handlers represented 19.5% of 46 cases reported to the Glasgow Health and Welfare Department between 1926 and 1949, bathing and accidental immersion were responsible for 13%, and 15.4% represented other occupations. Coal-miners, sewer workers, and fish workers together accounted for 50% of the Glasgow figures (Bell, 1953).

The incidence of leptospirosis in rats in Scotland has been estimated at 44% of 117 rats in the Aberdeen district by Smith in 1938 (56% of fully grown animals), while 37% of 166 rats in East Lothian were found to be infected (Buchanan, 1927).

Although Weil's disease has been notifiable in Scotland since 1924, *Leptospira canicola* is not, and records of previous human cases are limited to three described by Joe and Sangster (1951) and three mentioned by McIntyre and Seiler (1953), two of which (patients B and C) are also included in the present series.

Leptospiral infection of dogs on the other hand is very widespread, and surveys, e.g., by Stuart (1946) and Broom and MacIntyre (1948), have shown evidence of infection with *L. canicola* in 21 to 40% of dogs. The very low human infectivity of this organism at present in Scotland, however, is shown by the negative results of serological tests, which I carried out and which were reported by McIntyre and Seiler (1953), on the sera of 99 household contacts of dogs known to have had *L. canicola* infection at the time of contact.

The present report details 19 serologically confirmed cases of leptospirosis due both to *L. icterohaemorrhagiae* and *L. canicola*, which have occurred during the period October, 1950, to December, 1953, in south-east Scotland and one case in Falkirk. For the purposes of this report south-east Scotland is taken as comprising Edinburgh, the Lothians, Peebles, Roxburgh, Selkirk, and Berwick.

Methods

The serological data presented in this paper were obtained from the routine examination of sera carried out in the laboratories of the University of Edinburgh and the Royal Infirmary, Edinburgh. Information regarding epidemiology and clinical features was obtained from the clinicians concerned, and is published with their permission.

Blood specimens were received from hospitals and general practitioners and the sera were examined for the presence of agglutinins for leptospirae. Living cultures were used and a dropping technique similar to that of Schüffner and Mochtar (1927) was adopted. Results were read after two hours at 37° C. and a further two hours at room temperature by dark-ground microscopy. Strains of leptospirae used included *L. icterohaemorrhagiae* (Wijnberg), *L. canicola* (Berlin), and *L. canicola* (Utrecht IV).

Where possible, repeated samples of serum were examined until the titre against one or other of the two types was (a) at least 1 in 1,000 and (b) at least 10 times greater with one type than with the other. This ten-fold difference (usually it was even more) was taken as sufficient evidence, when occurring in the later stages of the disease, to indicate the causative type without the need for absorption tests.

Five rats which had been trapped alive on one farm were killed by coal gas and examined for leptospiral infection by injecting the emulsified kidneys into young white guinea-pigs. Cultures in Korthov's medium (modified as described in Mackie and McCartney's handbook, 1953) were made from the guinea-pig tissues when jaundice appeared, and their identity confirmed by agglutination to titre by stock antiserum.

Results

The occupational incidence of the series is shown in Table 1. It will be seen that the bulk of the cases occurred in the occupations of coal-miner and agricultural worker for both Weil's disease and *L. canicola* fever. The probability of contact with rats was established in 12 of the 14 cases of Weil's

disease and with dogs in three of five cases of *L. canicola* fever.

The incidence of Weil's disease and *L. canicola* fever according to locality is seen in Table 2.

TABLE 2
INCIDENCE OF LEPTOSPIROSIS ACCORDING TO LOCALITY

County	Town	Weil's Disease	<i>L. Canicola</i> Fever
Midlothian ..	City of Edinburgh	3	4
	Currie	—	1
	Loanhead	—	1
	Newtongrange	2*	—
East Lothian ..	Gorebridge	2	—
	Pencaitland	1	—
	Prestonpans	1	—
Roxburgh ..	Kelso	2	—
	St. Boswells	1	—
Berwick ..	Earlston	1	—
Stirling ..	Falkirk	1	—

*One of these two miners lived at Prestonpans in East Lothian, but worked in a Newtongrange pit known to be damp and rat-infested.

Although Earlston is in a different county from Kelso and St. Boswells, all these three towns are within 10 miles of each other. An examination of five rats trapped on the farm where one of the Gorebridge patients worked showed that four of the rats harboured *L. icterohaemorrhagiae* in the kidneys.

Incidence according to age, sex, and season was as follows. Cases of Weil's disease were fairly evenly distributed over the decades from 10 to 70. Those of *L. canicola* fever were limited to the age group 10 to 40. Of the three fatal cases of Weil's disease, all occurred in men over 40 and two of these were over 50. All the cases, both of Weil's disease and *L. canicola* fever, occurred in males, while 14 of the total of 20 occurred in the second half of the year (July to December inclusive). One case occurred in October, 1950, six in 1951, five in 1952, and eight in 1953.

The predominant clinical features, as shown in Table 3, included fever, headache (usually severe), vomiting, and jaundice. A raised erythrocyte sedimentation rate was present in all of the 15 cases in which it was ascertained. Urinary symptoms or signs, e.g., dysuria, increased frequency of micturition, albuminuria, pyuria, and red cells and casts in the urine, were present in eight out of 13 cases of Weil's disease and in two of the six of *L. canicola*. A haemorrhagic tendency was manifested in seven out of 13 cases of Weil's disease, but in none of *L. canicola* fever, by haemoptysis, haematemesia, melaena, epistaxis, bleeding into lip herpes, or generalized petechiae. Cerebrospinal fluid was taken in a total of seven instances out of the 10 in which meningeal signs were present, and these specimens showed a raised cellular content, mainly polymorphic

TABLE 1
INCIDENCE OF WEIL'S DISEASE AND *L. CANICOLA* FEVER
ACCORDING TO OCCUPATION

Occupation	Number of Cases		
	Weil's Disease	<i>L. Canicola</i> Fever	Total
Coal-miner	5	2	7
Agricultural worker	4	2	6
Gamekeeper	1	—	1
Steelworker	1	—	1
Blacksmith	1	—	1
Motor-driver	1	—	1
Schoolboy	1	—	1
Street orderly	—	1	1
Gasworks maintenance worker	—	1	1
Totals	14	6	20

TABLE 3
PREDOMINANT CLINICAL FEATURES

	Number of Cases		Total
	Weil's Disease	<i>L. canicola</i> Fever	
Fever (usually with rigor and varying between 100 and 104° F.)	11	5	16
Headache	Severe	8 (12)*	18 (18)
	Moderate	4 (12)	
Vomiting	11	4	15
Muscular pains	7	3	10
Injection of conjunctivae ..	6	2	8
Raised E.S.R. (12 mm. or more in the first hour) ..	11 (11)	4 (4)	15 (15)
Urinary symptoms or signs ..	8 (13)	2	10 (19)
Raised blood urea nitrogen (40 mg. % or more) ..	6 (8)	Not done	—
Jaundice	11	1	12
Haemorrhagic manifestations ..	7 (13)	0	7 (19)
Meningeal signs	5	5	10
Cerebrospinal fluid :			
Increased cells	3 (3)	4 (4)	7 (7)
Protein	2 (3)	4 (4)	6 (6)
Sugar over 50 mg. % ..	3 (3)	3 (4)	6 (7)

* The figures in parentheses refer to the number of cases in which observations were made, where this is less than the total number of patients involved.

(lymphocytic in one *L. canicola* case), and with raised protein. The sugar content was over 50 mg. %, with the exception of one specimen where it was 45 mg. %.

Blood serum agglutinin titres were of the usual high level associated with leptospiral infection. Apart from one rapidly fatal case, the maximum titre attained in any one case was always 1 in 1,000 or more, and in seven cases a titre of 1 in 30,000 or over was reached, four of these being cases of *L. canicola* fever, one of which gave a titre of 1 in 100,000 on two occasions. The rule already mentioned of requiring at least a ten-fold difference between homologous and heterologous titres occurring in the later stages of the illness was adhered to with the exceptions shown in Table 4.

TABLE 4
SEROLOGY OF CASES 5, 10, AND 18

Case	Days after Onset	Serum Titre* against	
		<i>L. icterohaemorrhagiae</i>	<i>L. canicola</i>
5	9	5,000	50
	18	10,000	Not done
	5 months	1,000	Not done
10	5	1,500	1,000
18	?	64	64

* Titres expressed as the reciprocal of the final dilution at the end-point.

In Case 5, the 100-fold titre difference against the two leptospira species on the ninth day of illness, together with the prolonged duration of the high titre against *L. icterohaemorrhagiae*, made the diagnosis of Weil's disease certain. Cases 10 and 18 died immediately after admission to hospital, in cholaemia. In these, jaundice and typical post-mortem findings, together with the history of contact with rats, completed the picture of Weil's disease.

Discussion

The fatality rates of three out of 14 cases of Weil's disease and three out of a total of 20 of leptospirosis (including those due to *L. canicola*) compare with Broom's (1951) mortality rate of 15% for England and Wales in 1947-50, the rate of 22% given by Broom and Alston for the period 1940-46, and the figure of 29% obtained from data concerning Scottish coal-miners published by Jenkins and Sharp (1946) and Sharp (1953).

Penicillin was given in 13 cases, but in only one was there any obvious effect, that of Case 8, where the patient was said to have "responded well" to 200,000 units thrice daily to a total of 4.2 mega units, with a marked fall of temperature during the first day of treatment. Since the penicillin was not given until quite late in the disease, it seems unlikely that the effect was due to the anti-leptospiral action of the drug. In the one fatal case which was given penicillin, treatment was not started until a week after the onset of the illness, and could not therefore be expected to affect the issue.

That there is a symptomatology common to the leptospiroses as a whole, with only relatively minor variations in kind between infections due to different serological varieties, is illustrated by the similar incidence of certain symptoms in Weil's disease and *L. canicola* fever in the present series. Thus fever of over 100° F., usually with rigor at the onset, moderate to severe headache, vomiting, a raised E.S.R., muscular pains, and injection of the conjunctivae occurred with nearly equal frequency in the two forms of leptospirosis concerned. Clinical differences included markedly greater frequency of jaundice and haemorrhagic manifestations in Weil's disease, and of meningeal signs in *L. canicola* fever. Urinary signs were recorded more often in Weil's disease. The high incidence of haemorrhages in Weil's disease is in accord with the higher fatality rate, but it should be noted that of the seven instances of haemorrhage, four occurred in patients who made a good recovery. The finding of a constantly raised E.S.R. is in accord with the results of Litzner and Hahn (1950), who were even

prepared to rule out the possibility of making a diagnosis of leptospirosis in the presence of a normal sedimentation rate.

Cerebrospinal fluid findings were in keeping with the generalized nature of leptospiral infection, but the relatively normal levels of sugar were in agreement with the observations of, for example, Glattkowski (1950), that concentrations of 50 mg. % or more are the rule in leptospirosis as against the lower levels found in tuberculous meningitis (Rubie and Mohun, 1949).

Summary

Nineteen serologically confirmed cases of leptospirosis occurred in south-east Scotland (excluding Fife) and one in Falkirk in the period October, 1950, to December, 1953, including 14 cases of Weil's disease and six of *L. canicola* fever.

Details are given of incidence according to occupation, age, sex, locality, and season, and the predominant clinical features are discussed.

Leptospira icterohaemorrhagiae were isolated from four out of five rats trapped in one of the localities concerned.

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