LEPTOSPIROSIS : A NEGLECTED HAZARD IN THE MEAT INDUSTRY?

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INTRODUCTION

Leptospirosis is a zoonosis and a recognised hazard for a variety of occupational groups, including food handlers, in many parts of the world (Van der Hoeden, 1964). Workers in the meat industry have been shown to be at risk in Europe, North America, Australia and New Zealand, and a brief review of previous studies on the incidence and serological prevalence of this disease in abattoir workers and meat inspectors has been published elsewhere (Blackmore et al, 1979).

Leptospira interrogans, the cause of leptospirosis in animals and man, is divided into more than 150 specific serovars, according to antigenic characteristics(W.H.O., 1967). Only a small proportion of these serovars will be endemic in any particular region or country. Leptospirosis is a disease which shows a natural nidality (Blackmore and Hathaway, 1979). In an area in which leptospirosis is endemic, each serovar tends to be maintained in specific maintenance hosts. Thus if the serovar causing a human infection can be identified, the likely source of infection can often be determined.

In New Zealand only six serovars are known to be endemic, but there is a high prevalence of infection in certain classes of domestic stock and wildlife. *Hardjo* is maintained in cattle, and *pomona* and to a lesser extent *tarassovi*, in pigs. *Balcanica* is maintained in possums (*Trichosurus vulpecula*), *ballum* in mice, rats and hedgehogs, and *copenhageni* in brown rats (*Rattus norvegicus*). The high endemic level of leptospirosis in cattle and pigs constitutes a potential occupational hazard for those in animal associated industries. The occupational hazard for dairy farmers is well known (Phillip, 1976) and more recently a hazard for meat inspectors has been demonstrated (Blackmore et al, 1979).

This contribution records the results of a serological survey of 1,250 abattoir workers and compares the results with a previous survey of 1,003 meat inspectors.

MATERIALS AND METHODS

Both meat workers and inspectors were given prior notification of the survey and volunteers requested to give a blood sample for subsequent testing for antibodies against *Brucella abortus*, *Coxiella burnetti*, *Leptospira interrogans* and *Toxoplasma gondii*.

Abattoirs were visited and approximately 15ml of blood collected by venepuncture from 1,250 meat workers from six abattoirs and 1,003 meat inspectors from 44 abattoirs. Each worker was interviewed and a questionnaire completed. Information was recorded concerning the age, sex and race of the individual and a wide variety of other variables including exact type of occupation and time employed, present or previous contact with animals outside the abattoir and previous history of clinical leptospirosis or other zoonoses. More than 90% of inspectors on duty at the time of the visit, and the majority of workers at two abattoirs were bled. At four other abattoirs the majority of the workers bled were those who were donating blood to the National Blood Transfusion Service.

Serum was removed from the blood after centrifugation and stored at -20°C until examined. A leptospiral microagglutination test (MAT) was carried out according to the method of Cole et al (1973) with an initial final serum dilution of 1:24. Cultures of *ballum*, *copenhageni*, *hardjo*, *pomona* and *tarassovi* were used as representative of the serogroups endemic in New Zealand. Both *hardjo* and *balcanica* belong to the Hebdomadis serogroup and cross react.

RESULTS

Tables 1 and 2 summarise the results recorded including the results obtained from 1,003 meat inspectors which have been recorded in greater detail elsewhere (Blackmore et al 1979). Preliminary analysis of the data obtained from an additional 211 meat inspectors from four more abattoirs revealed no significant differences in rates of serological prevalence and associations.

It will be noted that there is a significant difference in the overall prevalence rate of titres to leptospires of 6.3% in meat workers compared with the rate of 10.3% of meat inspectors ($P > 0.001$).

Scrutiny of the prevalence rates of the overall titres to specific serovars (Table 1) shows that the rodent associated serovars *ballum* and *copenhageni*, are the lowest. Although *tarassovi*, a pig associated serovar, was lowest in meat workers, it was the second most prevalent in meat inspectors. The rate of *hardjo* titres was less than 1.5% in both occupational groups, and although it is assumed that such titres are indicative of contact with infected cattle, it must be appreciated that *balcanica*, the possum associated serovar, cross reacts with *hardjo*.

Pomona titres, which can be associated with pig contact, were the most prevalent in both occupational groups. Titres to both *pomona* and *tarassovi* accounted for 85% of leptospiral titres in meat inspectors and 49% of titres in meat workers. Of 376 inspectors working at abattoirs processing pigs 52 (13.8%) had titres to these serovars compared with 36 (6.1%) at plants which did not slaughter pigs. This is a highly significant difference ($P > 0.001$). A similar highly significant association between work exposure to the processing of pigs and the prevalence of *pomona* titres was noted in meat workers ($P > 0.01$). This association was particularly obvious at works F (Table 1) which only processed pigs and where 23.1% of workers had titres to *pomona* although the plant had only been in operation for four years.

TABLE 1 : SUMMARY OF OVERALL PREVALENCE OF TITRES IN WORKERS AT DIFFERENT ABATTOIRS

Works	Number bled	Approx. % of total work force	Animals slaughtered	Specific Serovar Response										Total	
				hardjo		*pomona*		*tarassovi*		*copenhageni*		*ballum*			
				No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
A	224		sheep,cattle	6	2.7	13	5.8	1	0.04	1	0.04	4	1.8	25	11.2
B	124		sheep,cattle	0	0	3	2.4	0	0	6	4.8	1	0.8	10	8.1
C	232		sheep,cattle	1	0.4	6	2.6	0	0	9	3.9	0	0	16	6.9
D	588	70	sheep,cattle, pigs	9	1.5	9	1.5	1	0.2	2	0.3	1	0.2	22	3.7
E	56		sheep,cattle, pigs	0	0	5	8.9	0	0	1	1.8	0	0	6	10.7
F	26	90	pigs only	1	3.8	6	23.1	0	0	2	7.6	1	3.8	10	38.5
Total 6	1250		-	17	1.4	42	3.4	2	0.2	21	1.7	7	0.6	89*	7.1
Meat Inspectors	1003	76	-	12	1.2	78	7.8	19	1.9	4	0.4	1	0.1	114+	11.4

* include 10 dual reactions, i.e. total seropositive individuals = 79 or 6.3%
\+ include 11 dual reactions, i.e. total seropositive individuals = 103 or 10.3%.

TABLE 2 : ASSOCIATION OF SEROVAR REACTION WITH OCCUPATION

Type of Work	Number in Group	% with reaction to specific serovar					Overall % of serovar reaction
		hardjo	*pomona*	*tarassovi*	*copenhageni*	*ballum*	
With live animals in yards	60	nil	nil	nil	nil	1.7	1.7
Slaughter,evisceration and carcase dressing	364	2.7	6.6	0.5	1.9	0.8	12.6
Further processing of meat or offal	340	0.9	2.9	nil	1.8	0.9	6.5
In chillers & freezers	109	2.8	2.8	nil	nil	nil	5.5
Other type of employment within abattoir	323	nil	0.6	nil	1.9	nil	2.5
Meat inspection	1003	1.2	7.8	1.9	0.4	0.1	11.4

From the results of the questionnaires, a highly significant correlation ($P>0.002$) was shown between contact with pigs outside the abattoir and the probability of having a titre to *pomona*. This contact with pigs outside the abattoir could account for half the *pomona* titres of workers at abattoir A (Table 1) which no longer slaughters pigs.

A total of 21 concurrent reactions to two serovars were detected. Of these, 18 were to *pomona* with one other serovar (seven with *hardjo*, seven with *tarassovi* and four with *copenhageni*), two *copenhageni* with *ballum*, and one to *hardjo* with *ballum*. The concurrent reactions of *copenhageni* and *ballum*, *hardjo* and *pomona*, and *pomona* and *tarassovi* were significantly more ($P>0.001$) than would be expected by chance. This is indicative of a common source of infection of those workers with dual titres, e.g. rodents, cattle and pigs respectively.

Table 2 demonstrates the prevalence of titres in different occupational groups. Although meat workers were categorised into thirteen different occupational categories, these have been reduced to five in Table 2, for the sake of clarity. It was interesting to note that more than 70% of workers in each category had not changed their type of job within the abattoir. All the titres to *hardjo* and *pomona*, the two serovars associated with domestic stock, occur in workers concerned with the slaughter and primary processing of stock. The other three serovars show no obvious association with specific occupation except for *tarassovi* in meat inspectors.

The only significant difference ($P>0.001$) in the prevalence of titres between different racial groups, was a high rate (12.3%) of titres to *copenhageni* in South Pacific Islanders compared with New Zealand Maoris and Europeans (1%). None of these Islanders had titres to *ballum*.

Twenty three (22%) inspectors who had titres to leptospires had a history of previous clinical leptospirosis confirmed by a medical practitioner. This compares with 12 (15%) of meat workers. Analysis of the data relating to the onset of previous clinical disease in meat inspectors showed that titres detectable to a level of $\geq$ 1:24 can persist for at least 10 years (Blackmore et al, 1978).

DISCUSSION

From a knowledge of the epidemiology of serovars *ballum* and *copenhageni* and the results from this survey, it would appear that neither are occupational hazards in the meat industry. Both serovars are endemic in rodents and only cause rare and sporadic infections in domestic stock in New Zealand. Rodent infestation of an abattoir in New Zealand would be virtually impossible in view of the high standards of hygiene. If infection had been contracted from stock, it would be expected that the highest rates would be in workers concerned with the handling of carcases and fresh viscera as was the case with *hardjo* and *pomona*. However, the *ballum* and *copenhageni* cases occurred in all groups except those working in chillers and freezers. The dual reactions to *copenhageni* and *ballum* were significant and could indicate a common source of infection, i.e. rodents. However, the absence of *ballum* titres in Pacific Islanders suggests another source of infection for this group and it is tempting to postulate that the titres detected originated from previous infections in the South Pacific, where this serovar is apparently more common than in New Zealand. Therefore, although 79 meat workers (6.3%) had titres to leptospires it would appear that the titres to *copenhageni* and *ballum* should not be considered when assessing the true occupational risk of leptospirosis. Therefore by ignoring the *ballum* and *copenhageni* cases and correcting for concurrent titres, only 56 (4.5%) had evidence of occupational leptospirosis. Similar adjustment to the overall figure for meat inspectors would reduce the figure to 10%.

There was a highly significant association ($P<0.001$) in both meat workers and inspectors between working with pigs and having a titre to *pomona*, but not between processing cattle and having a *hardjo* titre. This is surprising in view of the similar high prevalence rates of *hardjo* infections in cattle and *pomona* infections in pigs.

Although cattle are considered the maintenance hosts for *hardjo*, *pomona* titres were detected in workers only handling cattle. This is not unexpected as sporadic *pomona* infections occur in cattle and surveys of dairy farmers show up to a third of serological recations are associated with this serovar (Phillips, 1976). Both *pomona* and *hardjo* titres were only observed in workers processing fresh carcases and viscera and no titres were demonstrated in maintenance workers and engineers. This is in complete contrast to prevalence of titres to *Brucella abortus*, where maintenance workers are in the group most at risk (Blackmore et al,unpublished). This difference might suggest that maintenance workers contract brucellosis by aerosol and leptospirosis is less likely to be contracted by this method. The surprisingly low prevalence of titres to *hardjo* compared with *pomona* cannot be explained and it is postulated that it may be a more persistant environmental contaminant than *hardjo*.

Although the overall figure for the prevalence of titres to leptospires has been estimated at 4.5% and 10% for meat workers and inspectors respectively, some of these seropositive cases will have been associated with contact with stock outside the abattoir. A significant association between *pomona* titres and contact with pigs outside the abattoir has been demonstrated and there is evidence for a similar association between *hardjo* titres and contact with cattle.

In conclusion it can be stated with confidence that leptospirosis is an occupational hazard for those employed in the meat industry in New Zealand, particularly if there is contact with pigs. However, other surveys have shown that the occupational risk to dairy farmers is apparently greater,and 30% may have titres to *hardjo* and *pomona* (Mackintosh et al, unpublished).

Although leptospirosis is relatively more important in New Zealand than many other countries, the overall serological prevalence in meat workers recorded in this survey is similar to the results obtained from less extensive surveys in Europe, North America and Australia. It is therefore suggested that leptospirosis may be a more important international occupational hazard than hitherto suspected.

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REFERENCES

Blackmore D.K., Bell, L. and Schollum, L.M.(1979) : Leptospirosis in Meat Inspectors; Preliminary Results of a Serological Survey, N.Z. med.J., 90:415-418.

Blackmore, D.K. and Hathaway, S.C. (1979) : The Nidality of Zoonoses. Proc. 2nd. Int. Symp. Epidemiology and Economics,Canberra, (in press).

Cole, J.R., Sulzer, C.R. and Pursell, A.R.(1973) : Improved Microtechnique for Leptospiral Microscopic Agglutination Test. Appl. Micro. 25,975-980.

Phillip, N.A.(1976) : Leptospirosis : New Zealand's No. 1 Dairy Occupational Disease, N.Z.vet.J. 24,6-8.

Van der Hoeden, J (1964) : Zoonoses. Elsevier Publishing Co. Amsterdam.

World Health Organisation (1967) : Current Problems in Leptospirosis Research : Report of a WHO Expert Group. World Health Organ Tech Rep. Ser. No. 380 (Geneva), 32.