

Enzootic pneumonia-pleurisy complex in sheep and lambs

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ABSTRACT

Seventy-nine to ninety-three percent of 49 young lambs less than 3 months old, which were too small to go to the meat works at the time of the first draft, showed sub-clinical lesions of enzootic pneumonia when examined post-mortem. Later samples from the same population showed that some, but not all, lambs developed pleurisy. During the months that the lambs were growing and fattening, the prevalence of enzootic pneumonia diminished while that of pleurisy increased. The increase in the prevalence of pleurisy was greater during the latter 5 months of the lamb-kill period and reached 11% of all lambs killed during July 1974. A higher prevalence of pleurisy was observed in sheep over 1-year-old killed at the meat works, indicating that the prevalence of pleurisy continued to rise beyond the first year of the lamb's life.

INTRODUCTION

The imposition of restrictions, requiring lamb and sheep meat essentially devoid of pathology, by some of New Zealand's export customers, has stimulated increased interest and awareness in the disease processes resulting in pleurisy. Because of these restrictions, pleurisy in lamb and sheep carcasses has resulted in some economic loss to sheep farmers through downgrading of carcasses, extra labour costs from additional processing of affected carcasses, and condemnations. It has been commonly accepted that pleurisy is not an entity but, rather, is part of a complicated pneumonia-pleurisy complex⁽⁷⁾. Enzootic pneumonia with pleurisy is a term commonly used and the one that will be used here.

Internationally, enzootic pneumonia-pleurisy is a major economic loss to the sheep industry. Deaths, retarded growth and reduced weight-gains in recovered animals, slaughterhouse wastage, and drug and labour costs make this an expensive disease.

The precise aetiology is unclear despite the work of many researchers⁽¹⁾⁽⁴⁾⁽⁵⁾⁽⁶⁾⁽¹⁰⁾⁽¹¹⁾. Methods of natural transmission are presumed but unproven; reliable preventive measures are non-existent; and treatment is frequently more empirical than specific.

Current knowledge of the aetiology of the pathogenesis of this disease-complex indicates that there are at least two phases.

The first phase, a "silent" or sub-clinical pneumonia⁽⁸⁾, is probably caused by viral, mycoplasmal and chlamydial organisms acting independently or in consort. In this phase, the lung lesions are generally small, usually located in the anteroventral portion of the lung, and consist mainly of varying degrees of collapse and consolidation⁽³⁾. Pleurisy will also be present in some cases. This sub-clinical phase may resolve, may remain in a chronic form, or may proceed to clinical pneumonia. Most affected lambs will reach slaughter weight and grade without a measurable set-back. Previous studies have indicated that lambs may have subclinical lesions as early as 45 days of age⁽⁸⁾, that the prevalence can be quite high (20-90%) and may vary between regions, and is discovered only at necropsy⁽⁹⁾ or at

the slaughterhouse.

The second phase is clinical enzootic pneumonia. This is generally considered to be the result of a secondary bacterial infection superimposed upon the initial subclinical condition. *Pasteurella multocida* and/or *Pasteurella haemolytica* are the two organisms most frequently incriminated⁽⁷⁾. It is unknown why so many lambs never progress from the subclinical to the clinical phase of this disease. Environmental "stress" is commonly advanced as a prime factor when the disease does progress from one phase to the other, but this remains unproved.

The clinical phase of enzootic pneumonia has been the object of most investigations in the past. This report is directed mainly at the subclinical phase of the disease.

EXPERIMENTAL DESIGN

Three farms A, B and C, were selected.

Farm A. This farm was selected because of a history of low prevalence of pneumonia-pleurisy. The farm was located in the Hawke's Bay area and was a market-lamb farm on easy hill-country producing 2 500 lambs annually. The meat-works' records for 1973-74 for its lambs indicated a prevalence of less than 1% of pleurisy. The owner's records of losses in adult sheep indicated a negligible loss from pneumonia during the winter of 1974.

Farm B. By contrast with Farm A, this farm, also located in Hawke's Bay, was selected because of a history of a high prevalence of pneumonia-pleurisy. This was a market-lamb farm on easy hill-country producing 3 000 lambs annually. The wethers were sold as market lambs, and the ewe lambs were over-wintered and sold as hoggets. The meat-works' records for its lambs during 1973-74 indicated a prevalence of more than 5% of pleurisy. The owner's records for the same period showed that more than 10% of ewe hoggets were lost from pneumonia.

Farm C. Farm C was selected because it afforded the opportunity to examine the possible effects that "stress" (in the form of transport of the store lambs) might have on the prevalence of enzootic pneumonia-pleurisy, and whether transport would exacerbate the existing subclinical infections. This farm was located in the Feilding area on steep hill-country. The farm supported 1 500 stud sheep plus 2 000 ewes for the production of market lambs. In "normal" years approximately 30% of the market lambs left this property as fat lambs and went directly to slaughter. The remaining 70% were weaned and transported to an easy hill-farm for further feeding before slaughter. The two farms were jointly owned.

The original plan was to examine the lungs of all lambs sent to the meat works from these three farms and record the prevalence of enzootic pneumonia and pleurisy. Further, each time fat lambs were drafted for slaughter, a group of 15-20 small lambs from the same farm were to be selected and transported to Wallaceville Animal Research Centre for necropsy. The purpose was to compare the prevalence of enzootic pneumonia-pleurisy in the young apparently healthy lamb, with the prevalence in the older market lamb. In selecting these younger lambs, care was to be taken to exclude animals showing any clinical signs of illness.

The same experimental procedures designed for Farms A and B were established for Farm C. In addition, the group of small,

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store lambs from this farm were necropsied just before transport to the easy hill-farm, and a second sample was necropsied approximately 2 weeks after their arrival at that farm.

RESULTS AND DISCUSSION

The exceptionally wet summer of 1975-76 resulted in such an abundant pasture growth that the original experimental design was not wholly feasible. Thus, two-thirds of the lambs from Farm A had been sent to the meat works before adequate communications could be established and hence the lungs of most of these lambs were not examined by the investigators at the time of slaughter. However, the meat works' inspection records for these lambs were available. Thus, the prevalence of pleurisy was established but not that of subclinical enzootic pneumonia.

Again, because of excellent feed, only a small number (300) of the store lambs from Farm C were transported from the home farm to the lower farm, thus eliminating the possibility of collecting significant data on the effect of "stress" in the form of transport on the prevalence or aggravation of enzootic pneumonia-pleurisy. Additionally, labour strikes in many freezing works disrupted the experimental slaughter schedule. Despite the difficulties encountered, considerable data were collected (Tables I and II).

Precise lambing dates were not available for the small lambs submitted for necropsy at Wallaceville but, from the history and size of the lambs, they were judged to be approximately 90 days old. The prevalence of subclinical lesions of enzootic pneumonia in these young lambs was high, ranging from 79% to 93% (Table I). None of the lambs were showing any sign of infection, nor was there an outbreak of clinical enzootic pneumonia in any of the farms during the investigation. Thus, it would appear that many young lambs experienced subclinical disease which did not progress to a clinical level.

In addition, the ratio of enzootic pneumonia-pleurisy in young lambs at necropsy (Table I) and older flock-mates at slaughter (Table II) is interesting. In both circumstances, there

TABLE I: PREVALENCE OF ENZOOTIC PNEUMONIA AND PLEURISY ON NECROPSY IN YOUNG LAMBS FROM THREE NEW ZEALAND SHEEP FARMS

	Date	EP	%EP	PL	%PL
Farm A	Nov 75	14/15	93	0/15	0
Farm B	Nov 75	12/15	80	2/15	13
Farm C	Jan 76	15/19	78	3/19	16

EP = enzootic pneumonia
PL = pleurisy

TABLE II. PREVALENCE OF ENZOOTIC PNEUMONIA AND PLEURISY AT TIME OF SLAUGHTER IN MARKET LAMBS FROM THREE NEW ZEALAND SHEEP FARMS

	Date	Lungs examined	EP	PL
Farm A	Nov 75	1026 ⁽¹⁾	Not Recorded	3
	Feb 76	235	96	6
Farm B	Nov 75	273	96	5
	May 76	233	149	36
Farm C	Feb 76	253	172	16
	Mar 76	406	268	28

EP = enzootic pneumonia
PL = pleurisy

⁽¹⁾ These lambs were slaughtered without examination by the investigators. The figures shown were taken from the owner's meat works receipts.

TABLE III. PREVALENCE OF PLEURISY: 1974-75 SEASON

REPORTING STATION	Lambs Killed	Percent Prevalence	Sheep Killed	Percent Prevalence
North Island				
Taranaki	1 598 714	4.3	512 212	22.0
Auckland	2 923 558	4.9	1 334 161	22.3
Gisborne-Hawkes Bay	4 456 003	4.8	886 079	26.5
Wellington	2 255 530	3.7	980 647	21.0
Totals North Island	11 233 805	4.5	3 693 099	22.8
South Island				
Nelson-Marlborough	506 899	2.3	147 918	15.5
Canterbury	3 288 580	1.2	768 495	13.0
South Canterbury North Otago	2 896 892	1.5	622 474	17.6
Otago	1 929 324	3.2	376 358	17.6
Southland	5 348 951	2.0	1 015 598	14.6
Totals South Island	13 970 646	1.9	2 930 807	15.3
Totals New Zealand	25 204 451	3.1	6 623 906	19.5

was a markedly higher prevalence of enzootic pneumonia than pleurisy. Furthermore, there was a reduction in the prevalence of enzootic pneumonia between the younger and the older lambs on Farms A and B of 56% and 21% respectively, whilst there was an increase of 2.6% and 18% respectively in the prevalence of pleurisy. Presumably, some of the enzootic pneumonia lesions resolved while the lesions of pleurisy persisted because of their fibrous composition. Further evidence to support this thesis is presented below.

Prevalence of pleurisy in sheep and lambs: 1974-75 season.

Records kindly supplied by the Meat Division of the Ministry of Agriculture and Fisheries for October 1974 to July 1975 showed that 19.5% of the 6 724 376 adult sheep slaughtered had pleurisy (Table III) and that this was the main reason for downgrading carcasses. Pleurisy constituted 32.5% of all downgraded adult sheep carcasses. In the same period 3.1% of the 25 229 099 lambs slaughtered had pleurisy. At this level pleurisy constituted 19.4% of all reasons for downgrading lamb carcasses.

Pleurisy in Lambs

There was some variation between reporting stations on each Island (Table III). However, limitations of only 1 year's data, and the intra-island shifting of lambs for slaughter, precludes drawing any conclusions regarding the prevalence of pleurisy within each Island. However, the magnitude of difference in prevalence between the North Island (4.5%) and the South Island (1.9%) was substantial. Although the data represents only 1 year, there was no inter-island shifting of lambs for slaughter and therefore the result should be reliable. It is sufficient for the purpose of this report to point out this difference and also that similar geographical differences have been reported elsewhere⁽⁹⁾.

Plotting data (Fig. 1) for each of the nine reporting stations, and for the North and South Islands separately, produced parallel curves, although the South Island had a markedly lower prevalence of pleurisy.

These data showed that the first 5 months contained 63% of the kill but only 20% of the pleurisy. Conversely, the second 5 months with 38% of the kill, accounted for 79% of the disease. Obviously, the older or later lambs had a higher prevalence of pleurisy.

The prevalence of pleurisy in both Farms A and B followed the national pattern, but with some difference in magnitude. Thus, Farm A was only slightly below the national average for February, whereas Farm B experienced a prevalence approximately four times greater than the national average for November and twice that for May. It should be recalled that Farm A was selected because of a history of low prevalence of pleurisy and Farm B for a history of high prevalence. There were no lambs slaughtered from Farm B in February, hence no comparison could be made.

The prevalence of pleurisy increased in January 1974 and continued to do so until July 1975 (Fig. 1 (b)). One can only speculate whether this is due to an increase of enzootic pneumonia-pleurisy in the lamb population during the season, or whether infection at the subclinical stage of this disease complex actually causes a retardation of growth and fattening. The latter thesis would explain the increasing occurrence of pleurisy in the lamb-kill as the season progresses and it is inviting to accept this. Kirton *et al*⁽⁸⁾ showed that enzootic pneumonia had some effect on the growth rate of lambs during the period January to March, but further work will be required, using more detailed and sophisticated measurements, to confirm this.

The increasing prevalence of enzootic pneumonia-pleurisy in

the lamb population may be a function of increasing exposure with age. Previous work⁽⁹⁾ indicates that lambs are free of sub-clinical enzootic pneumonia lesions at 6 weeks of age, but exhibit over 60% infection rate at weaning and at slaughter. Data presented here demonstrated subclinical enzootic pneumonia in 80-90% of the lambs at approximately 3 months of age (Table I). Presumably, lambs were born free of the disease but became infected some time after 6 weeks old. The infection was quite widespread at 3 months old. As the young lambs had little or no exposure to sheep other than those on the same farm, it seems reasonable to assume that the dam is the reservoir of infection. Initially, transmission was most likely to have occurred from ewe to offspring followed later, perhaps, by lamb to lamb contact.

Furthermore, because of the absence of subclinical enzootic pneumonia at 6 weeks old, but widespread infection at 3 months old it would appear the newborn lambs enjoyed a temporary immunity. Such phenomena in the newborn are characteristic of the passive immunity gained through the ingestion of antibodies with colostrum.

Widespread subclinical enzootic pneumonia at an early age presumably sets the stage for the concomitant or subsequent development of pleurisy. It is accepted that pleurisy is a sequel of the complex enzootic pneumonia-pleurisy disease process⁽⁷⁾. However, it has been demonstrated that the number of lambs with subclinical enzootic pneumonia, that also develop pleurisy, is quite variable (Tables I and II).

Furthermore, it appears from the same data that at some point after 3 months old the prevalence of subclinical enzootic pneumonia diminished, that is from 79-93% in young lambs at necropsy to 35-68% in older flock-mates killed at the slaughterhouse. Paradoxically, while the prevalence of subclinical enzootic pneumonia was decreasing the prevalence of pleurisy was increasing. Figure 1 (b) shows a steady increase from

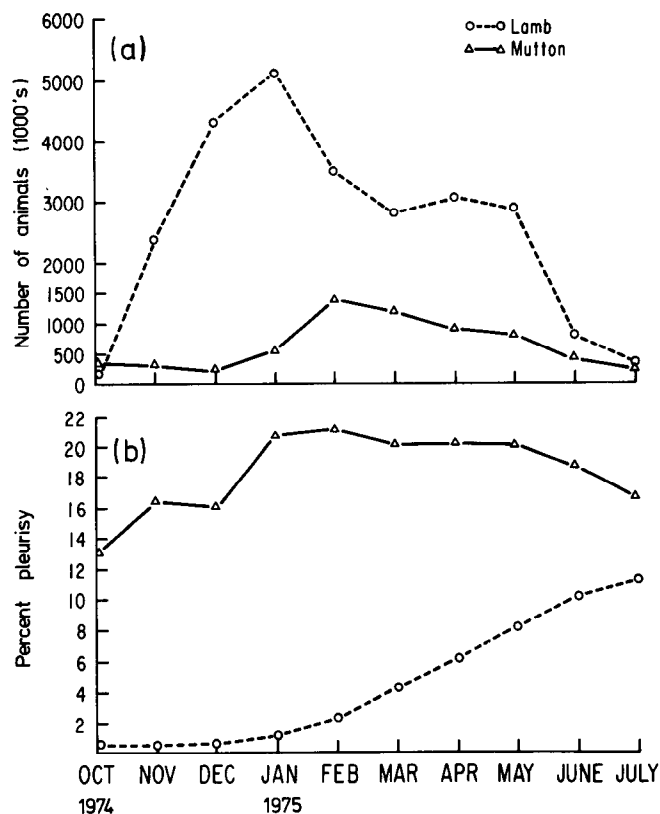


Fig. 1 (a). Sheep slaughtered Oct 1974-July 1975

(b). Percentage of pleurisy in sheep Oct 1974-July 1975

0.42-11.1% in the lamb-kill from October 1974 to July 1975. Also, the prevalence was still rising at the end of the killing season.

The steady rise in the prevalence of pleurisy during the season indicates that the factors initiating the pleuritic lesions in lambs are present from shortly after 6 weeks old until slaughter. Additionally, the chronic, fibrotic nature of the pleurisy lesion will ensure its presence at slaughter. Thus, new cases of pleurisy plus the persistence of older cases are the most likely explanation of a steady increase in the prevalence of this disease during the season.

Sheep Pleurisy

The prevalence of pleurisy in adult sheep started quite high (13.1%) but reached a peak of 21.0% in the fifth month (Fig. 1 (b)). Thereafter, there was a gradual decline to 16.7%. The difference in the prevalence between the North and South Islands, was in a similar direction to that seen in the lamb-kill but the magnitude was smaller.

The prevalence curve of pleurisy flattened out as the season progressed. No data were collected, but observations in the meat works indicated that, even though the prevalence of pleurisy remained high in these older sheep, the prevalence of subclinical enzootic pneumonia was much lower than that recorded in the lamb-kill. It seems probable that the decline in subclinical enzootic pneumonia, observed in lambs between 3 months old and slaughter, continues into the second year of life.

If the curves plotting the prevalence of pleurisy in the lamb-kill and the sheep-kill (Fig. 1 (b)) are viewed successively the trend in the lamb curve is continued in the curve of the older sheep. It should be re-emphasised that the conclusion that these two curves are related must be speculative since we are comparing two different populations of animals lambled in different years. However, the result is quite possibly a record of the course

of pleurisy in sheep, starting with the young lamb and progressing into adult sheep.

It is difficult to assess the economic loss caused by pleurisy and pneumonia in stock. Kirton and others⁽⁸⁾ estimate that the effects of enzootic pneumonia on the growth of lambs was not economically significant. However, if the losses due to the downgrading of pleuritic carcasses are added to their findings the situation may change. It is difficult to arrive at a figure for the cost of downgrading carcasses at the meat works. The costs of processing are almost wholly carried by the farming community. When additional costs, such as losses due to death, veterinary fees, medicine and labour are added to these other losses it may be that significant economic loss is occurring due to pneumonia-pleurisy.

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