MALIGNANT OEDEMA OF LAMBS IN NORTH-WESTERN QUEENSLAND.

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SUMMARY.

Heavy mortalities in lambs after marking are shown to be due to infection by Clostridium septique through the scrotal wounds.

Effective control may be achieved by carrying out lamb-marking operations in temporary yards.

INTRODUCTION.

There is no dearth of information on anaerobic infections of domestic animals, but there are not many records in Australian veterinary literature of heavy mortalities in lambs due to *Clostridium septique* infection of castration wounds.

Scott, Turner and Vawter (1935) classified malignant oedema as a wound infection and this appears to be the accepted opinion. Edgar (1931) recorded mixed anaerobic infections following crow pecks of sheep in New South Wales. Borthwick (1943) studied factors which influenced infection by *Cl. septique* and he concluded that reduction of the activity of the alimentary tract, and to a less extent exposure to cold, predispose to infection through the alimentary tract. Steward (1944) described malignant oedema in swine probably due to *Cl. septique* but was unable to determine the mode of infection in all cases. He suspected an alimentary route in six of the nine outbreaks recorded and considered that inoculation with serum or vaccine appeared to be a factor in precipitating some *Cl. septique* infections.

Oxer (1935) stressed the importance of fatness in predisposing sheep to black disease and entero-toxaemia and he is of the opinion (Oxer, 1947) that fatness predisposes to anaerobic infections generally. Bosworth (1943) stated that *Cl. septique* is frequently present in the intestinal canal of healthy animals. Kranveld and Djaenoedin (1940) reported that *Cl. septique* is often present in the bile of healthy cattle slaughtered in Java. Seddon and Edgar (1930) surveyed the occurrence of anaerobes and found *Cl. septique* in 28 per cent. of samples obtained from dairy yards. Of those obtained from cultivated (wheat) lands 20 per cent. were contaminated by *Cl. septique,* whilst the organism was recovered from only 8 per cent. of the soil samples obtained from grazing land. *Cl. septique* was not demonstrated in any of the soil samples obtained from completely virgin soil, i.e. from land that was completely uncultivated and ungrazed.

An investigation was made by one of us (G.R.M.) into mortality in young rams on a property between Winton and Hughenden in 1942. The animals died on being unloaded after a long train journey, and the symptoms and post-mortem findings were consistent with a *Cl. septique* infection. This was confirmed by laboratory examination but the route of infection was not established.

A mortality in rams was investigated by one of us (G.R.M.) in central-western Queensland in 1943. Four hundred rams had been culled from a stud when they were about 14 months old and were castrated at a set of permanent yards. The scrotum was slit and the testicles removed by an emasculator. About 40 animals had died within six days and another 50 seemed likely to die. Laboratory examination of specimens by one of us (A.K.S.) revealed *Cl. septique* to be present and the symptoms and post-mortem lesions were consistent with a *Cl. septique* infection.

Losses in lambs after marking (i.e. castration, docking and earmarking) have been reported on several occasions in Queensland. The common sequelae previously recorded have been blowfly strike, suppurative and non-suppurative polyarthritis due to *Corynebacterium pyogenes* and *Erysipelothrix rhusiopathiae* respectively, tetanus and shock (Edgar, 1931). In addition, it has been known for some years that heavy mortalities (from 10 per cent. to 50 per cent.) have occurred in recently castrated male lambs in north-western Queensland and the circumstances suggested that an anaerobic infection was responsible.

In north-western Queensland lambing percentages (i.e. percentage of lambs marked to ewes mated) are very low, 50–60 per cent. being considered a good figure while the average is in the vicinity of 35–40 per cent. In addition many years occur when seasonal conditions are so bad that it is not possible to mate the sheep at all. The summer rains, which predominate, are very unreliable. Hence the usual practice is to mate when the rains fall and there is assurance of 5 to 6 months of feed (mainly Mitchell and Flinders grasses) rather than to mate in anticipation of rain and good feed for lambing. As prolonged periods of hot weather occur during summer (Kynuna for instance having 6 consecutive months with average daily maxima over 95°F.), it seems likely that the fertility of the rams would be low (Gunn *et al.*, 1942). In addition, mating after the first heavy summer rains means lambing when the ewes are on a falling plane of nutrition, and when much of the surface water is drying up so that the pregnant ewes or the ewes and their young lambs have to travel long distances over open shadeless downs to water. Under such conditions the wastage of both lambs and breeding ewes is high and mortalities in lambs which have been raised to marking age assume considerable importance.

The cases described in this paper relate to heavy mortalities in lambs after marking. They occurred in north-western Queensland during the winters of 1944 and 1945. At least a dozen properties in the Richmond-Maxwelton districts were affected and on many of them the deaths exceeded 25 per cent. of all lambs marked. The trouble was confined to male lambs and usually the fattest and best grown were affected. Deaths commenced about 3 days after marking, were heavy on the 4th, 5th and 6th days and subsided after the 7th day. Gas gangrene developed in the inguinal region and there was marked lameness in the hind limbs prior to death.

In 1944 one property reported losing 1,500 lambs from 5,700 marked. Another lost 1,200 from 6,400 and another 783 from 4,800 marked. One owner reported marking 3,500 lambs just after the July rains of 1944. The sheep were

handled in five lots with one day between each marking. No trouble occurred amongst the first lot, but three died from the second, about 35 from the third, over 200 from the fourth, and out of the fifth, which comprised 845 lambs, 400 died. The total loss was about 700 lambs. As about 50 per cent. of all lambs marked are males the losses amounted to almost half of this sex.

On most of the properties the flocks were depastured according to age, and the various groups were mustered independently for marking. The experience quoted above was typical in that no losses were recorded in the flocks first marked, but mortalities occurred in the lambs from the flocks subsequently handled and the severity of the outbreak increased with each succeeding lot of lambs.

Permanent yards were used for handling the sheep at marking time. The yards on one property were at least 45 years old. Some of the yards were watered well to lay the dust.

The trouble seems to have been most marked after the unseasonable winter rains which fell in both 1944 and 1945. The weather after these rains was, however, warm and sunny.

On all properties the usual method of castration was used, the scrotum being "tipped" in order to expose the testicles. On some properties a blowfly dressing or an "antiseptic" solution was applied to the marking wounds. Mortality was not associated with any specific dressing, nor with flocks in which no dressing was used.

INVESTIGATIONS.

An investigation was carried out at a property south of Maxwelton during the four days July 27–31, 1945, when losses were occurring under circumstances similar to those reported during the previous year.

History.

The seasonal conditions in 1945 were good. Heavy summer rains were followed by 218 points in May and 225 points on July 10.

Marking was commenced at the shearing-shed yards early in July and about 700 lambs were drafted and then earmarked, castrated and tailed.

The sheep were yarded in the afternoon and next morning the lambs were drafted into a "check pen," at one end of which the cradles were mounted. After marking, the lambs were released in a large yard where the ewes were held to allow "mothering." Thus the sheep were in the yards about 24 hours. No wound or fly dressing was applied and no losses occurred.

The marking was interrupted by a ram shearing and when this was in progress the July rains fell. Three hundred rams were worked through the yards, which were still damp.

Lambmarking was resumed on July 14, when a flock of 2,000 ewes with 59 per cent. of lambs was handled. The work was completed on July 16. When the flock was inspected four days later, 18 wether lambs were found dead in the paddock and over 50 were either sick or dying.

On July 21, a total of 284 lambs was marked, and when inspected four days later wether lambs were dying. In a short search of the paddock (6,000 acres) six days after marking 25 dead lambs were found. One sick lamb was taken for post-mortem examination.

On July 24, 550 lambs were marked and 24 dead and 23 dying wethers were seen three days later. The marking technique was varied with this flock in that the scrotum and the tail stump of the male lambs were sprayed with a phenolic solution after the castration and tailing operations. As might be expected, this treatment did not prevent subsequent mortality. The ewes were allowed into a small well-grassed lane beside the yards and were held there to allow mothering. On being released, the lambs ran straight through the large holding yard, which had previously been used for mustering, into the lane. On July 27, 700 lambs were marked under similar circumstances, 40 being found dead within three days. In all cases the lambs' tails were cut at about the same length, and the stump was just long enough to cover the tip of the vulva in ewe lambs. In the males the tails were of comparable length. The total deaths on this property in 1945 amounted to 800 lambs from 6,152 marked.

Symptoms.

Sick lambs from a flock which had been marked three days earlier were examined during the afternoon of July 27.

They segregated themselves from their mothers and did not graze or suckle. They stood about with back arched, head down and subsequently lay down in lateral recumbency. Some lambs lay quietly when approached and were easily caught. Others showed a remarkable degree of activity and it was difficult to catch them. These animals showed lameness in one or both hind legs and in some cases were unable to flex the limb.

There was a hot oedematous swelling of the inguinal region and scrotum. Oedema extended along the belly and past the prepuce, which was swollen and reddened. The skin of the groin and abdomen exuded a sanguineous serum which stained the wool covering these parts. The skin over the groin was desquamated and the wool from the belly plucked easily.

Temperatures of over 106°F. and respirations of over 120 per minute were recorded. The pulse (rate 80 per minute) was inclined to be bounding. Later the pulse rate rose to 200 per minute and the heart was tumultous. The conjunctival mucosae were injected.

Post-mortem Findings.

Three male lambs were examined about 30 minutes after death. They had been marked three and six days previously. In each the castration wound was closed, and the scrotum was enlarged and filled with dark clotted blood.

The wall was oedematous and purplish-red, and when cut a purplish serous fluid was exuded. There was a large oedematous swelling over the groin and along the belly. The skin over the whole of this area was discoloured and exuded a blood-stained serum. The skin inside the legs was desquamated.

In some cases the discolouration spread from the scrotum over the perineum to the base of the tail. The wound on the stump of the tail was healing satisfactorily. The skin of the abdominal wall was thickened and discoloured and the subcutis was oedematous and exuded a dark-purple serous fluid. The abdominal muscles were discoloured; their blood vessels were engorged and the fibres were swollen and friable. This gave a "soggy, water-logged" appearance.

The parietal and visceral peritoneum was inflamed and was marked with large splashy haemorrhages. The liver was parboiled, the spleen slightly oedematous and the lungs petechiated.

The pericardium was extremely thickened, measuring about three-eighths of an inch, and it contained deep-purplish clotted exudate. The heart was very enlarged and the surface vessels were engorged and tortuous. The epicardium and endocardium were petechiated; the myocardium showed blotchy discolouration and was friable. There was dark clotted blood in the ventricles and a frothy blood-stained discharge from the nose.

Where the discolouration extended to the muscles of the perineum the fibre bundles were enlarged, dark and friable.

Bacteriological Examination.

Films from the peritoneal surface of the livers of three lambs were stained by Gram's method. They showed large numbers of Gram-positive bacilli. Filaments up to 10 μ in length were present and some organisms contained an oval subterminal spore.

Sealed Pasteur pipettes of the exudate from the abdominal wall of one lamb and from the scrotum of another both yielded cultures of *Clostridium septique*.

Pipettes were cultured in a cooked-meat medium (incubated aerobically) and on ox-blood agar plates (incubated anaerobically). On the plates apparently pure cultures of clear round colonies surrounded by narrow zones of haemolysis were present after 24 hours' incubation. The cultures from both lambs had the morphological characters of *Cl. septique*.

Subcutaneous injection of 0·5 ml. of an 18-hour culture in cooked-meat medium killed guinea pigs (about 450 gm. weight) in 18 to 40 hours. The usual features of *Cl. septique* infection were noted, including the presence of long Gram-positive filaments on the peritoneal surface of the liver.

Four mice inoculated intraperitoneally with 0·2 ml. of culture died in 24 hours, whereas four mice inoculated with the same dose of culture plus 0·2 ml. of *Cl. septique* antitoxin (Commonwealth Serum Laboratories) showed no ill effects.

The infecting organism was thus identified as *Cl. septique*.

Control Measures.

Previous experience in the sheep industry indicated that heavy losses associated with lamb marking can be prevented by carrying out the work in temporary yards. Accordingly some temporary yards were erected in a corner of one of the shearing-shed paddocks and 615 lambs were marked on July 28. All instruments were boiled and the male lambs were castrated and tailed by one of us (G.R.M.). The scrotum was "tipped" in the usual fashion; two "Luck" lamb marking knifes were used for the work, one being immersed in a strong "Dettol" solution while the other was in use. The ewes were tailed by the owner's son, who followed the procedure he had adopted at the previous markings after which trouble had occurred. The tail length adopted for the ewes was long enough to cover the tip of the vulva and that for the wethers was comparable. On being released the lambs ran into the paddock to the ewes, which were held for mothering.

Three days after marking five of the wether lambs had died. The symptoms and lesions were identical with those already described. No further sick lambs were seen but when the sheep were moved about a week after marking 10 lambs were missing.

The same procedure was used subsequently to mark 986 lambs in temporary yards on another part of the property and 15 dead lambs were found during the week following marking. These losses were less than those usually experienced in Queensland after marking male lambs: the estimate of one of us (G.R.M.) is that on most properties in Queensland $2\frac{1}{2}$–3 per cent. of male lambs die each year after marking.

DISCUSSION.

The occurrence of the disease in male lambs only and the nature of the lesions leave little doubt that the infection gained entrance through the scrotal wounds. The tail length adopted at marking was that which according to Johnstone (1944) is most likely to assist rapid and uncomplicated healing. This may have been a factor in preventing mortality amongst ewe lambs, leaving the scrotal wounds of the males as the portal of infection. On the other hand, tail wounds are probably not of a type suitable for the germination and growth of anaerobic bacilli.

As the lambs were not drafted from their mothers until the morning they were marked, they were not subjected to prolonged starvation. This may have been sufficient to reduce the activity of the alimentary tract; but the possibility of infection through this route seems remote, especially as the weather was not cold.

The work of Bosworth (1943) and of Seddon and Edgar (1930) and to some extent Kranveld and Djanoedin (1940) suggests that much-used stockyards are places most likely to be heavily contaminated with *Cl. septique* spores. The increasing severity of the losses as the marking proceeded and the almost complete cessation of trouble when the marking was done in temporary yards might be regarded as confirmatory evidence of this. Topley and Wilson (1936) state that

spores of *Cl. septique* are widely distributed in the few inches of topsoil. They also consider that the presence in the wound of kataphylactic agents such as calcium salts is necessary for the development of a gas-gangrene lesion following the introduction of spores. Thus the reduction of losses by marking in temporary yards may have resulted from the lack of kataphylactic substances in the soil about temporary yards or from a lighter infection of *Cl. septique* spores.

A comparative study of the contamination by *Cl. septique* of sheep yards and paddocks in various parts of Queensland has not been undertaken. The soils of western Queensland are considered to contain an adequate amount of calcium, but no figures comparing the calcium content of the soils of sheep yards and paddocks are available.

The apparent association between the losses and the winter rains is also of interest. Under the conditions of management practised winter rains ensure fat, well-grown lambs, and Oxer (1947) considers fatness predisposes animals to anaerobic infections.

The losses amongst lambs which were allowed to "mother" in the grassed lane suggest that infection may have been picked up prior to the animals being castrated. The severity of the losses already experienced on the property where the mortalities were investigated did not permit further markings being undertaken in the permanent yards for experimental purposes.

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