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Urinary calculi of sheep in Western Australia

H. W. Bennetts

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URINARY calculi or "stones," according to reports received by the Department of Agriculture during recent years, appear to be one of the most important causes of deaths in wethers and rams in the more eastern agricultural districts.

An investigation of this problem was commenced towards the end of 1949 with object of determining:

(a) The types of calculi affecting sheep in these areas.

(b) The causes and mode of formation of the calculi.

(c) Means of preventing the resultant losses from urinary obstruction, or "water belly," in rams and wethers.

The initial step was a survey of the region referred to in order to obtain information defining the problem, and to arrange for the co-operation of sheep owners in experimental work. It was found that the calculi commonly occurring were those composed principally of silica. In consequence our investigations, which are continuing in the field and the laboratory, have been concerned particularly with the causation of siliceous calculi.

Losses from urinary calculi, however, are by no means restricted to the region referred to, nor to this one type of calculus, and the purpose of this article is to give a general account of the problem with particular reference to local conditions. This account is based on published information from elsewhere, much of which was reviewed by Beveridge (1942), and on data collected in this State. The problem, however, is still very incompletely understood and no satisfactory means of control are yet available.
A GENERAL ACCOUNT OF URINARY CALCULI

1. Occurrence.

Urinary calculi have been reported from many countries. In England and America they are found most frequently in sheep being hand fed on a rich diet for show or for the market. In South Africa and Australia they are common in arid areas with a dry hot climate.

Reference will be made, later, to the circumstances of occurrence in this State.

2. Symptoms.

The presence of calculi in the kidney or bladder is not recognised until they pass on to cause partial or complete obstruction of the urinary tract, usually of the urethra (the passage conveying urine from the bladder to the exterior). In consequence their presence is not recognised in the ewe during life, as the larger more dilatatable female passage permits of the animal passing them. In the male, particularly the wether, however, blockage of the narrow urethra is likely to occur at the urethral process, the sigmoid flexure or the ischiatic curve (see Fig. 1).

The first symptom is restlessness and occasional straining to urinate. The wool around the pizzle is nearly always wet and may be encrusted with salts. Later there is evidence of pain, the gait is straddled and the back arched. The bladder becomes distended with urine and ruptures within 48 hours of the stoppage. This is followed by distension of the abdomen and death within 24 hours to several days. In some cases the obstruction passes on before rupture of the bladder occurs in which case recovery is spontaneous, although the condition may recur due to the presence of further calculi.

3. Post Mortem Appearances.

Following rupture of the bladder the body cavity contains a large quantity of blood-stained fluid. The bladder and urethra are inflamed. The obstruction calculi may be found in the sites mentioned. They may also be seen in the bladder, kidneys or sometimes in ureters (see Figs. 4, 5 and 6). The kidneys may be enlarged and the pelvis dilated, or may be small and shrunken due to chronic inflammation.


The more commonly reported calculi in sheep consist either of phosphates or of calcium carbonate (carbonate of lime). Among the factors considered to contribute to their formation are the following:

(a) Vitamin A Deficiency.—When the vitamin is deficient certain changes occur in the lining membranes of the kidney and other parts of the urinary tract, leading to the formation of debris which may act as a focus for the accumulation of salts (e.g. phosphates and carbonates) present in the urine.

(b) Imbalance of Calcium and Phosphorus.—It has been found that when the diet contains a great excess of calcium over phosphorus or vice versa the occurrence of calculi is favoured, particularly if Vitamin A is deficient.

Cereal grains and bran contain a gross excess of phosphorus over calcium, whereas with lucerne and clovers the reverse is the case. There is some evidence also that the amount of magnesium ingested may be a factor.

(c) Mineralised Drinking Water.—It has been suggested that this may play a part, although the evidence is not very strong. It is possible, however, that waters containing high concentrations of calcium or magnesium might have the effect of balancing or unbalancing the mineral content of the diet and thus tend either to control or favour the occurrence of calculi.

(d) Concentration of Urine.—A great reduction in the volume of urine may occur during hot dry weather, on a dry hay or concentrated diet, or with lack of water.
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(e) Bacterial Infection.—Bacterial infection of the urinary tract is frequently found in cases of calculus but this may be the result and not a contributing cause of the condition.

5. Prevention and Treatment.

It is obvious that prevention must depend primarily on a knowledge of the particular factors contributing to the occurrence of the calculi, and the correction or modification of these factors.

Treatment is generally unsatisfactory. If the blockage is in the urethral process the calculus can sometimes be removed, or the process may be amputated. If the blockage is higher up the calculus can sometimes be massaged outwards. Even if the immediate obstruction is removed, however, recurrences are apt to follow.

With certain types of calculi, changing the reaction of the urine by administration of acid-forming medicines (or by starvation) is sometimes effective in dissolving calculi and, if continued, in preventing their formation.

URINARY CALCULI IN WESTERN AUSTRALIA

As indicated earlier the occurrence of calculi has been reported widely in this State but the condition appears to constitute a serious economic problem only in the Eastern Districts and in the “clover belt” where “clover stone” has caused the death of many valuable rams.

1. The Eastern Agricultural Districts.

During recent years losses of up to 10 per cent. of rams have been commonly experienced; in wethers the mortality appears to be higher. The following deaths were reported from five widely spaced properties in 1949:—30 out of 90, 41 out of 90, 50 out of 150, 50 out of 250, and 50 out of 500 wethers. The first four sets of figures refer to Merino weaners. A number of sheep owners have discontinued holding wethers beyond the age of about six months because of the heavy mortality experienced even during their first summer and autumn.

Losses commence generally towards the end of the dry period, from March onwards and continue after the advent of green feed until June or July. In dry years deaths may commence earlier and cease later. Long dry seasons appear to favour the incidence of the condition; this was particularly heavy in 1949 when, moreover, losses were spread throughout the year.

Young animals, notably weaners and two-tooths, appear most susceptible, but this susceptibility may be more apparent than real as it is a common practice in these areas for wethers and stud rams to be disposed of at an early age, so that only a small number of older males remain on the property.

It is evident that sheep maintained in good condition and heavily hand fed during the dry period are much more likely to be affected than those which are less well fed. Feeding on stubbles, unstripped oats, and with oat grain supplements from February or March until the advent of green feed is a fairly general practice throughout.

Few sheep other than Merinos are carried in this region so that we have no evidence regarding breed susceptibility. Southdowns however, are known to be affected. The evidence to date indicates that serious losses are associated with heavy grey or red calcareous soils, under arid conditions. Only sporadic cases have been reported from similar soil types in
“Lake Country” where sheep get a green picking throughout the dry period; or on lighter soil types.

With regard to water supply, information so far available suggests that this is, generally, not an important factor. It is, however, one which cannot be dismissed from consideration, and which will be investigated.

The Type of Calculus Causing Obstruction.

A large number of calculi, obtained from affected sheep throughout the agricultural areas, have been received and examined at the laboratory. These have been of two types (a) Calcium carbonate calculi and (b) Siliceous calculi.

Either type may cause obstruction and both may be encountered on the same property. It seems evident, however, that the siliceous calculi are much more common and are the main cause of economic loss in the agricultural areas.

Our investigations, which are continuing intensively, are therefore concerned with this type of calculus.

(a) Calcium Carbonate Calculi.—These are of the size and shape of small shot with a smooth polished “metallic” surface. They are hard in consistency and, commonly, greyish in colour. The colour, however, varies; in one instance gilded stones were found. They are found in the bladder and commonly cause obstruction of the uretha. On analyses these calculi are found to consist largely of calcium carbonate (carbonate of lime).

(b) Siliceous Calculi.—These are quite different in appearance. They are commonly of the size and shape of a grain of wheat but may be larger and may be irregular “chips.” They have a rough uneven surface are whitish in colour on the surface, and are friable or easily powdered. These calculi are apparently formed in the kidney and are found in the pelvis of that organ, giving an appearance like that in Fig. 4. They have been commonly

Fig. 4.—Debris in pelvis of kidneys—An early stage in calculus formation
(American Journal of Veterinary Research)
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encountered in the kidneys of ration sheep on one property where, remarkably, urinary obstruction has not been encountered in the wethers or stud rams. Few farmers appear to have observed these calculi in the kidney but it is believed that they must be fairly commonly present for it is evident that obstruction of the urethra commonly results from siliceous calculi; one ram breeder reported that he has frequently found them blocking the ureter in rams dying from urinary obstruction, in which case they are obviously derived from the kidney.

On analysis these calculi are found to be composed largely of silica, an inert substance which is present in large amounts in the soil (e.g. sand grains are composed largely of silica) and in many plants, notably in hay. It is known that the urine of herbivorous animals, as a result of their diet, may contain relatively large amounts of silica. Siliceous calculi, however, have not been described as of common occurrence in sheep except in parts of the United States of America and in this State. Little is known of the mechanism of their formation.

More recent observations have confirmed the fact that sheep maintained under normal grazing conditions in our agricultural areas excrete large amounts of silica daily in the urine, whether on green or on dry feed. In consequence the urine, voided in small volume while sheep are on dry feed, is highly charged with silica. It seems, therefore, that under these conditions, only slight or transient alterations in urine composition could result in precipitation of the silica, leading to calculus formation.

We have no evidence that any of the other factors referred to earlier contribute to the formation of siliceous calculi.

On the other hand the occurrence of calcium carbonate calculi may be related to one or more of these factors, or also to the consumption of plants containing a high oxalic acid content.

Fig. 5.—On right, a hypertrophied kidney containing a clover stone. The kidney on left is smaller than normal size (atrophied) (By courtesy of H. T. Carroll)

2. Urinary Obstruction on Parakeelia.

Since 1925 we have received not infrequent reports of mortalities in wethers from ruptured bladder occurring when Parakeelia composed the dominant or only grazing available to sheep, notably in certain seasons in the Murchison and Goldfields Districts.

It is only recently, however, that we have found that the urethral obstruction in these cases is due to the presence of calcium carbonate calculi, identical with the type described above.

It appears possible that the calculi may be formed under these circumstances on account of the demonstrably high oxalic acid content of the plant, Talapatra et al (1948) having shown that the consumption of excessive quantities of this acid by cattle may lead to high urinary excretion of alkaline carbonates. It is possible also that the plant may irritate the urinary tract thus contributing to the deposition and concentration of the calcium carbonate. Further evidence is required on these aspects.

3. Calculi Associated with Subterranean Clover—“Clover Stone.”

Very early in the investigation of infertility of sheep grazing dominant sub-
terranean clover pastures* we recognised that the presence of an unusual type of calculus in the kidneys of sheep was a common occurrence on clover properties. Some investigation of this condition was also carried out, but only passing reference has so far been made to it, the first detailed published description being that of Carroll (1949).

The calculi are formed in the substance of the kidney where small yellow, granules can be seen. These collect in the pelvis as “sand” which commonly aggregates to form a stone which becomes moulded into the shape of the pelvis and calyces of the organ. The calculus material is sulphur yellow in colour and the calculi are yellow throughout. They are moist, soft and very friable, being easily broken up. They vary in size from grains of sand to very large stones up to three ounces in weight, when the kidney substance is, not uncommonly, reduced to a shell surrounding the calculus (see Fig. 6). The kidneys may be enlarged and hypertrophied, or small and shrunken.

It is remarkable that despite extensive damage to one, or even both kidneys, ewes may be in good condition and in apparent good health. Wethers and rams, however, may show the usual symptoms of urinary calculus described earlier, yellow encrustations being common around the pizzle. Carroll has noted deaths in rams from urinary obstruction.

The calculi have been analysed in this laboratory and found to differ in chemical composition from any of the calculi reported in literature. The mineral content is extremely low, the total ash content being below 2 per cent.; the nitrogen content is very high.

The exact nature and mode of formation of these calculi has yet to be determined, but there seems no doubt that extensive grazing of subterranean clover (Trifolium subterranean var. Dwalgunup) is primarily responsible for their formation. It seems probable that they are composed principally of inflammatory exudates resulting from an irritant substance in the plant, the colour being due to pigments derived also from the clover. In that connection a rusty staining of wool around the urinary orifices is common in clover-grazed sheep. It would appear that the prevention of “clover stone,” as of infertility, must be based on measures designed to prevent sheep from regularly eating excessive amounts of subterranean clover. Detailed recommendations for the control of “clover disease” have been given by Shier and Rossiter (1949).

Fig. 6.—A yellow clover stone (top) which weighed approximately 3 oz. and is a perfect cast of the lumen of the hypertrophied kidney (below) from which it was removed (By courtesy of H. T. Carroll)

* See this Journal (1947), 23:1.
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4. Control.

In the present state of our knowledge there are no measures which can be recommended for the prevention of urinary calculi in sheep.

As regards siliceous calculi it appears probable that an increase in daily output of urine during the dry feed period would have a beneficial effect. There are, however, no known practicable means of achieving this end, at least in this environment.

The investigation of the problem is being continued in the hope that further knowledge may lead to the finding of some means of prevention.

SUMMARY

(a) Present knowledge of the occurrence, signs, and possible causes of urinary calculi in sheep is briefly reviewed.

(b) Our present very incomplete knowledge of this condition in Western Australia is presented and discussed in relation to findings elsewhere.

(c) Urinary calculi, and the resultant urinary obstruction, are known to be the source of serious economic losses in the Eastern Agricultural Districts. Siliceous calculi have been found to be the type principally responsible; the investigation of this problem is being continued.

REFERENCES


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