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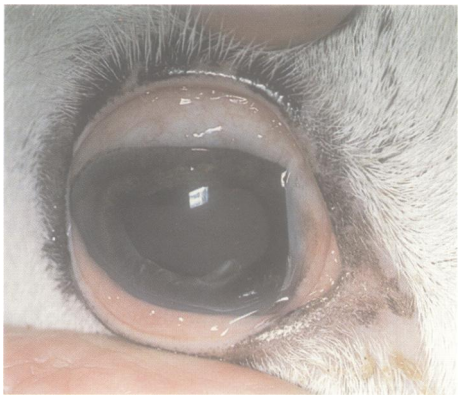


Dilated pupil in a blind ewe. Blindness is one of the early signs of pregnancy toxaemia

Pregnancy toxaemia in the ewe

ANTHONY ANDREWS

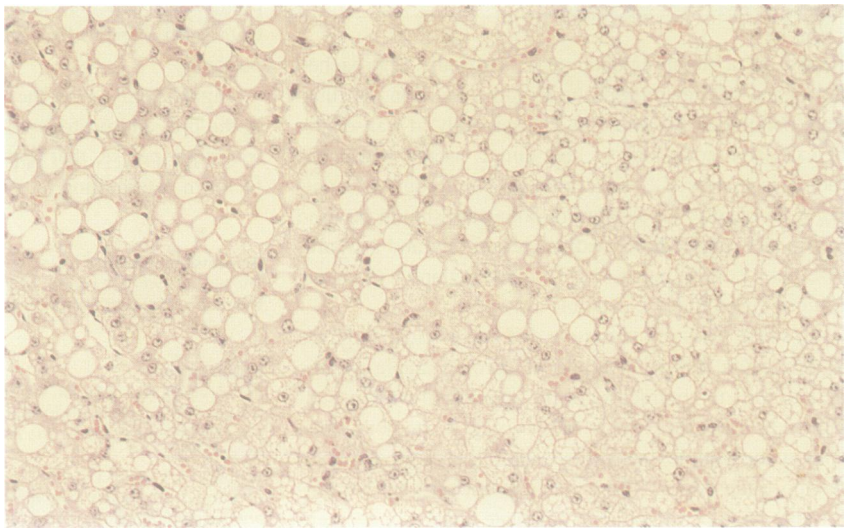
Anthony Andrews qualified from the Royal Veterinary College in 1965. After a period in mixed practice and then back at the RVC studying for a PhD, he joined the Meat and Livestock Commission, becoming a senior veterinary officer. In 1979, he joined the RVC as senior lecturer in farm animal medicine. He developed a considerable interest in nutritional problems and has recently undertaken projects involving the use of recombinant bovine somatotrophin in the treatment of fat cow syndrome and pregnancy toxaemia in ewes. He recently left the RVC and now works as an independent consultant in farm animal management and disease. He is an RCVS-recognised specialist in cattle health and production.

PREGNANCY toxaemia, or twin lamb disease, is a common and important disease of late pregnancy. With the drive to increase lambing percentages, and margins dependent on feed costs, the problem has become widespread, particularly in intensively farmed, lowland flocks; the condition is rarely seen under extensive conditions. Many farmers will be faced with a few cases annually, but in certain years up to 40 per cent of ewes in a flock, and possibly 2 per cent of the national flock, may be affected. Control of the disease relies on close attention to nutrition, from as early on as one month before tupping.

AETIOPATHOGENESIS

While the full aetiology is still not completely understood, pregnancy toxaemia is essentially a severe form of ketosis, characterised by low circulating blood glucose and high ketone body levels. It generally affects ewes carrying two or more fetuses or a single large lamb. Susceptibility to pregnancy toxaemia varies widely: some individuals are more vulnerable than others, probably due to reduced hepatic metabolic efficiency; likewise, some breeds appear to be more predisposed to the condition than others.

Cases tend to occur in early lambing flocks, especially where there is inadequate feed provision. Typically, there is a gradual fall in the plane of nutrition, followed by a period of starvation or stress due to a management or climatic change; for example, a spell of severely cold, wet or windy weather, particularly where there is inadequate shelter, may result in the ewes attempting to shelter rather than graze. Paradoxically, the movement of sheep to good pasture, housing or the supply of better quality feed can trigger the problem, usually by causing a temporary inappetence. High helminth burdens are another risk factor, predisposing to ketotic development, while broken-mouthed ewes or those which are weak or debilitated are also very vulnerable.



Fatty liver, seen under medium power magnification, showing swollen vacuolation of the hepatocytes with the nuclei pushed to the cell periphery

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Clinical pathology

In most cases of pregnancy toxaemia seen on the farm, there will be a progressive decrease in the blood glucose level (normal, 1·7 to 3·6 mmol/litre) and an increase in blood ketone bodies. The latter are usually measured as betahydroxybutyrate (normal values vary with the laboratory, but are usually taken as being below 0·8 mmol/litre); levels above 1·6 mmol/litre indicate severe energy undernutrition, while those between 0·8 and 1·6 mmol/litre suggest moderate undernutrition. Usually, when clinical signs develop, plasma betahydroxybutyrate levels are said to be above 3·0 mmol/litre, but this does depend on the laboratory.

Cerebrospinal fluid analysis has been suggested as offering a better guide to the ewe's clinical status. Fructosamine has also been examined as a diagnostic aid.

About 20 per cent of ewes with pregnancy toxaemia are hypocalcaemic (normal calcium levels, 2·3 to 3·2 mmol/litre) due to the high circulating cortisol levels and the fatty liver interfering with hydroxylation of vitamin D. Liver damage is often apparent, with raised plasma levels of aspartate aminotransferase and glutamate dehydrogenase. Blood urea may also be high, possibly from catabolism, decomposing fetuses or terminal uraemia. Urine ketone levels tend to be high. Postmortem aqueous humour betahydroxybutyrate levels above 2·0 mmol/litre are considered diagnostic.

The inappetence which often precipitates the signs of pregnancy toxaemia can result in hypocalcaemia and/or hypomagnesaemia. These metabolic conditions may precede or occur simultaneously with ketosis.

Pregnancy toxaemia tends to occur in the last six weeks of pregnancy when two-thirds to three-quarters of the lamb birthweight is gained. This is a time when there is increasing competition for space within the abdomen as each fetus rapidly increases in size. While the problem is often associated with ewes which are thin, it can be seen in the fat ewe where there are even more abdominal space constraints. Thus, the main problem is one of a progressive net energy deficiency at a time of increased fetal energy demands.

The low energy intake results in a gradual fall in blood glucose levels, depletion of liver glycogen, and fat mobilisation with ketone body formation. As blood ketone levels rise and glucose falls, clinical signs manifest. However, their onset may not relate to the extremes of hypoglycaemia or hyperketonaemia. In some animals, the developing hypoglycaemia, which may be exacerbated by an inhibition in glucose utilisation by the brain, leads to an, often irreversible, hypoglycaemic encephalopathy. Blood cortisol levels are raised as a result of reduced hepatic metabolism as well as the hypoglycaemia and continuing stress levels. Metabolic acidosis, dehydration and renal failure occur in the later stages of the disease.

POSTMORTEM FINDINGS

The carcase is usually either emaciated or in good condition with large quantities of abdominal and subcutaneous fat. The liver is usually enlarged, pale and friable, with fatty degeneration. It varies in colour from pale pink to bright orange-yellow, is often greasy to the touch and, in some cases, will float in water. The fetuses may have died and undergone some autolysis, in which case they will be surrounded by thick, viscous, brown-black material. The adrenal glands are usually enlarged with haemorrhagic cortices. The renal lesions are often poorly defined and there may be cerebral lesions. Constipation is usually a feature but, in some animals, fetid, light-coloured diarrhoeic faeces are present.

CLINICAL SIGNS

The early stages – when the ewe may be apart from the main flock and may not come up for feeding – are often missed. There may be some bleating as blindness sets in and the animal is separated from the rest of the flock. Often, when approached these sheep will stand facing the person, apparently blind and with head held erect, rather than running away. They may be seen colliding with fences and other objects, show varying inappetence, and usually lack a menace response.

Clinical signs as the condition progresses, include dullness, teeth grinding, muscle tremors (particularly of the head and neck), salivation, jaw champing and constipation. Individual animals may show one of several other, less common, signs such as head pressing, standing in a corner or in water, star-gazing, circling or persistent drinking. The ewes are often hyperaesthetic to tactile or auditory stimuli; thus, they are difficult to restrain once caught. Later in the clinical course, progressive ataxia and weakness become evident. The sheep tends to adopt a wide-based stance and proprioceptive reflexes are reduced or lost. Some ewes go down and have bouts of tonic-clonic convulsions.

Most ewes become recumbent after three or four days and, although initially can stand if helped up, later cannot support their own weight. Once down, the lack of abdominal muscle tone becomes apparent, with the abdomen splaying out on either side. With continued recumbency, urine scalding of the abdomen and hindlegs occurs. The ewe ultimately becomes severely depressed, often lying with her head on the ground, and may smell uraemic. The animal may show some temporary

Recumbent ewe showing lack of abdominal muscle tone

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'Wool break' in a ewe which has recovered from pregnancy toxaemia

improvement if the fetuses die (occasionally the ewe will abort the fetuses either alive or dead), but this is usually followed by even more profound depression. Towards death, there may be light-coloured or yellow, foul-smelling diarrhoea. Generally, the animal becomes comatose and dies in about three to six days.

Ewes that recover often go on to develop dystocia at lambing and, not uncommonly, die during parturition. Those that lamb often do not rapidly expel the fetal membranes, which may subsequently lead to metritis and, ultimately, death. Frequently, the lambs are born dead, or small and weak. These ewes generally produce little milk; hence, the lambs are susceptible to hypothermia, watery mouth and diarrhoea, and postparturition mortality tends to be high. Hypomagnesaemia may be a feature in the early lactation phase.

To treat or not to treat?

The prognosis for ewes with pregnancy toxaemia is very difficult to establish – animals with apparently very severe signs will sometimes recover while those with mild illness may rapidly deteriorate. It is useful to determine, by ultrasound or auscultation, whether the fetuses are alive. If they are not, the prognosis is even poorer and it is probably not worth undertaking treatment. Recumbency is often also a poor prognostic sign.

TREATMENT

Many different forms of therapy have been advocated, all of which involve the administration of glucogenic substances. However, the response to treatment is usually poor, as success is so dependent on detecting the condition early to ensure a quick return to a normal appetite.

Concentrated glucose/electrolyte mixtures, propylene glycol or glycerol are often given orally; care is required as, in the last two cases, overdosage can lead to diarrhoea. Intravenous glucose injections can be helpful, particularly if they can be given once or twice daily, and may be used to supplement oral therapy. Insulin injections, to aid cellular uptake of glucose, are found beneficial by some clinicians. Vitamin B injections can help ensure their availability for energy metabolism. Corticosteroids, administered by injection or orally, have been used both to assist in gluconeogenesis, producing a euphoric state and increased appetite, and to trigger abortion; however, they are often unsuccessful for the latter, possibly because there are already high endogenous cortisol levels. The fetuses may be removed by caesarean section to eliminate the energy drain on the ewe and allow the sheep to survive for another breeding season; however, even when undertaken early, success rates are often disappointing. Intravenous calcium borogluconate is helpful in those ewes with hypocalcaemia.

Experimentally, the use of recombinant bovine somatotrophin, administered by subcutaneous injection, has achieved equal or better success rates than conventional therapy. It appears to improve the efficiency of glucose and ketone body usage at cellular level, thereby reducing mortality of both ewes and fetuses.

During treatment, the ewe should be removed from the flock and kept in a pen to provide shelter. Good quality feed should be provided and the animal encouraged to eat.

CONTROL AND PREVENTION

Pre-tupping and first month of pregnancy

Control measures at this stage amount to nothing more than good feeding practice and husbandry. The key is the frequent monitoring of the ewes to determine their condition scores, with adjustments made to their feed as necessary. The animals should be on a rising plane of nutrition for about four weeks before mating: this normally entails transfer to good quality pasture. At tupping, the sheep should be at an ideal condition score – 3·5 for lowland breeds and about 3·0 for hill breeds.

This level of feeding should be maintained for the first six weeks of pregnancy, ideally, to ensure implantation in all sheep conceiving in their first two oestrous cycles. Any change at this time may reduce implantation rates and may also lead to early embryonic death.

Second and third months of pregnancy

With implantation safely achieved, the second and third months of pregnancy are a phase of placental growth. By the end of the third month, the placenta will be fully developed and the fetus(es) will be about 15 per cent of their birthweight. Under ideal conditions, the ewe will maintain her bodyweight during this stage but, because of the demands of pregnancy, her body condition will reduce by about half a score.

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ENERGY REQUIREMENTS (MJ/DAY) FOR TWO TYPES OF EWE

Breed type	*Liveweight*	*No of lambs*	*Maintenance*	*Weeks before lambing* 5	4	3	2	1
Hill breed	40 kg	Single	5·8	6·1	6·7	7·4	8·2	9·1
		Twins		6·1	7·1	8·2	9·5	11·0
Lowland breed	70 kg	Single	8·8	8·9	9·9	10·9	12·1	13·4
		Twins		9·2	10·6	12·3	14·2	16·5

Overfeeding of ewes at this time will result in fat deposition, with the risk of pregnancy toxaemia later on or, possibly, smaller lambs. If more than three-quarters of a condition score is lost, ketosis will again be more likely towards lambing and lamb birthweights may be reduced.

Fourth and fifth months of pregnancy

During months 4 and 5 of pregnancy the fetuses grow by over 80 per cent of their birthweight; meanwhile, there is minimal further growth of the placenta. The efficiency of weight gain by the fetus is poor (ie, about 13 per cent); thus, if ewe feeding is wrong, the lambs' weight will be affected and there will be an increased risk of pregnancy toxaemia developing.

It is critical that the ewes are condition scored early in this period to ensure that any deviations in condition score in the whole flock can be identified and corrected. A dietary regimen can then be planned for the flock up to lambing. The ewes should be condition scored at least fortnightly during the fourth and fifth months of pregnancy and the feeding plan modified, if necessary. As lambing approaches, there will probably be the need for supplementary feeding. Adequate trough space must be provided and a check kept to ensure that all ewes come up to feed. The feed itself should be divided into two meals daily.

Ideally, the ewes should be divided into three groups according to their condition score to enable a more concerted feeding regimen. This will give a large group containing all the ewes at roughly the same score and two smaller groups, one with (thin) ewes with lower and the other with (fat) ewes with higher condition scores. Any growing ewes will need to be placed in a separate group or with the thin ewes, as will those with broken mouth.

The 'thin group' will need to be fed from earlier on and with greater quantities than the other groups. The 'fat group' should, as far as possible, be fed to lose weight but without compromising them metabolically. A diet of straw or poor quality hay together with a small quantity of fish meal or soyabean meal daily to provide adequate rumen undegradable digestible protein (UDP), and possibly vitamin and mineral supplementation, will maximise utilisation of body fat reserves. These overweight animals should be kept on bare fields and made to exercise by walking between fields to receive the feed. The net effect should be some loss of weight with

Rule of thumb guide to energy requirements

Second and third months of pregnancy
1 x maintenance

Late pregnancy
Single lamb 1·5 x maintenance
Twins 2 x maintenance

Lactation
Single lamb 2·5 x maintenance
Twins 3 x maintenance

Choice of feed

The choice of feed is very important as pregnancy progresses and abdominal space becomes more limited. The aim must be to provide nutrient-dense rations in the last few weeks of gestation. A few farmers produce a complete diet, but this is very rare.

Good quality grass hay is often a good form of roughage in the diet. Ideally, the hay should be analysed for its nutritional content. While poorer quality hay can be fed in mid-pregnancy, it is important to ensure that it is highly nutritious towards the end. The high dry matter content ensures a low bulk intake.

Straw has a relatively poor energy value, but a high dry matter content. If fed as a source of roughage, it is essential to keep it fresh and to offer several times the required amount so that the ewes can be selective.

If silage is to be fed, it should be of good quality, palatable and well fermented. Analysis of its nutritional content should give a 'D' value of 65 per cent, dry matter (DM) content of 25 to 30 per cent and a metabolisable energy level of 10·5 MJ/kg DM. If silage is used as a source of forage, it is important to ensure that all ewes are eating it – occasionally, an individual animal will reject it. If it has a low DM content, the quantity of silage should be reduced in late pregnancy and some hay or good quality straw offered.

Concentrates can be offered in the form of a proprietary compound or cereals with some protein and a vitamin and mineral supplement. Root crops are a useful source of energy but, because of their high moisture content, should be restricted in late pregnancy.

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maximum utilisation of the energy produced by the fetus(es), with the exercise ensuring more efficient use of the ketone bodies produced.

The aim of feeding during this period is gradually to introduce, and then increase the amount of, concentrates in the diet so that sufficient energy is available for fetal growth. The ewe's appetite will decrease in the last two or three weeks because of the competition for space within the abdomen, and it is important to compensate for this. If feeding has been ideal, the average lowland ewe will have increased in weight by about 20 per cent, but will still have a condition score of 2·5 or less.

The protein requirements during most of pregnancy are not high, provided the crude protein level is at least 8 per cent. However, in the last month before lambing the requirements increase, to meet the demands of the growing fetus(es), ensure sufficient quantity and quality of colostrum, and for subsequent milk production. These are most easily met by the provision of UDP, commonly supplied as fish meal or roasted soyabean meal. As with the fat animal, this allows the most efficient use of the ewe's own body fat reserves.

A factor often overlooked in nutrition, and which can result in a reduced feed uptake, is access to clean, fresh water. This is particularly important in late pregnancy and lactation.

Acknowledgement
The histopathology picture of the fatty liver, on page 306, was kindly loaned by Dr B. Smyth, Department of Pathology, Royal Veterinary College.

Further reading

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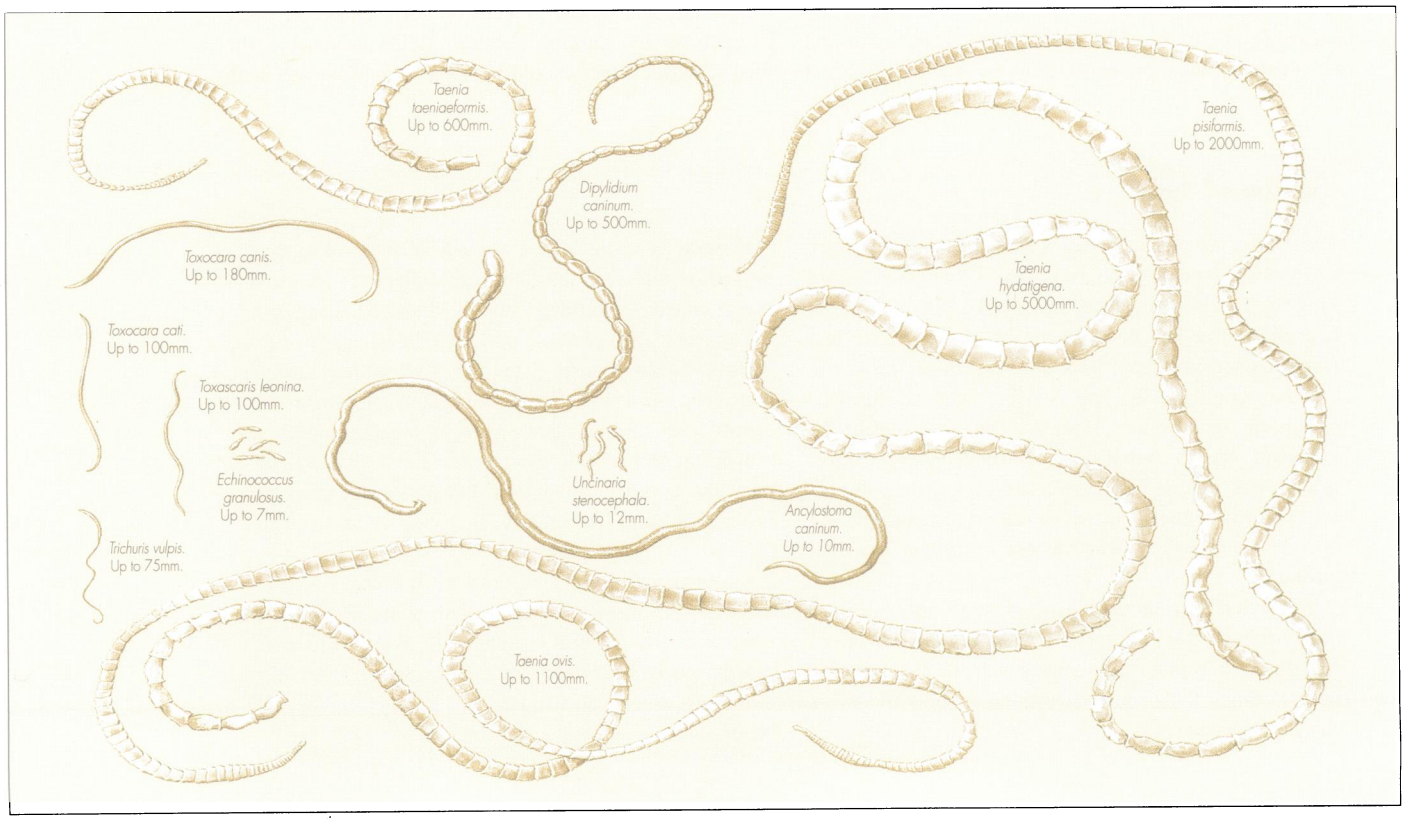
A DOZEN WORMS



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