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CASE REPORT

Food/farmed animals

Valvular endocarditis in a 10-month-old ewe lamb: The diagnostic benefits of on-farm ultrasound examination

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Abstract

Valvular endocarditis was diagnosed during a routine flock screen for ovine pulmonary adenocarcinoma (OPA) in a 10-month-old ewe lamb with a 2-month history of weight loss. Ultrasound examination demonstrated right caudoventral pleuritis presenting as hyperechoic thickening of the pleura and irregular hyperechoic lesions measuring approximately 12–15 mm, replacing the normal tricuspid and mitral valves. The sheep was euthanased for welfare reasons, with ultrasound findings confirmed on postmortem examination. Considering the poor prognosis and welfare concerns associated with the condition, this case report demonstrates the practicality of ultrasound to diagnose valvular endocarditis on-farm and facilitate prompt euthanasia.

BACKGROUND

Valvular endocarditis is a common cause of mortality in cattle, while the diagnosis is poorly described in live sheep. The pathogenesis of bovine and ovine disease is similar; typically, a primary bacterial infection elsewhere in the body predisposes to bacteraemia, with adhesion and colonisation of circulating bacteria on heart valves.¹ Unlike cattle, diagnosis in sheep can be challenging from physical examination alone because cardiac-specific clinical signs are uncommon.^{2,3} The presenting signs commonly reported in sheep are non-specific, including lethargy, exercise intolerance, weakness, low body condition score, multiple limb lameness, joint effusions, respiratory disease, ascites and sudden death.⁴ With the chronic presentation of valvular endocarditis, it is important to reach a confirmatory diagnosis, as euthanasia for welfare reasons is indicated due to the guarded prognosis.

Thoracic ultrasonography is becoming increasingly useful in farm animal practice investigations,^{5,6} whether for an individual animal or as part of flock screening programmes for ovine pulmonary adenocarcinoma (OPA). When screening flocks for OPA, being able to distinguish between other thoracic conditions avoids incorrect diagnosis in the surveillance programme, and in the case of valvular endocarditis, it avoids prolonged suffering. This case highlights the usefulness of thoracic ultrasonography to confirm diagnosis on a farm.

CASE PRESENTATION

The flock comprises three breeds: Scottish blackface (1900), Texel (60) and blueface Leicester (60) sheep. Biannual whole-flock screening and culling of suspected OPA cases identified ultrasonographically over 6 years reduced the disease prevalence from 3.4% to less than 0.3%. In February 2022, approximately 950 breeding sheep were scanned over 7 hours as part of the OPA screen. The farmer expressed concern over a 10-month-old blueface Leicester ewe lamb with a 2-month history of weight loss. The farmer suspected respiratory disease, and the sheep had been treated with antibiotics on three occasions (8 ml long-acting oxytetracycline twice [Alamycin 200 mg/ml] and 7 consecutive days of 3 ml procaine penicillin injections [Norocillin 30%]) without improvement. Clinical examination revealed a very low body condition score of 1 (scale 1–5), dull demeanour with a low head carriage and reluctance to stand. A jugular pulse greater than two-thirds up the neck was noted, and the respiratory rate was increased between 25 and 35 breaths per minute at rest (Video S1). The heart rate was irregular and elevated above 90 beats per minute with a grade 5/6 holosystolic murmur. Rumen turnover and fill were low considering that the animal had free access to herbage. Rectal temperature was normal (38.1°C); there were no other significant abnormalities.

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INVESTIGATIONS

Initial ultrasound examination (DP50 machine, imv imaging, 6.5 MHz microarray probe) of the lungs revealed hyperechoic thickening of the pleura at 10–15 mm depth covering the ventral lung lobes on the right side of the chest (Video S2). Ultrasound findings were consistent with pleuritis, but the extent of pathology was considered insufficient to cause the clinical signs. On-farm ultrasound examination of the heart in the standing sheep revealed irregular hyperechoic lesions measuring approximately 12–15 mm replacing the normal tricuspid and mitral valves (Video S3). No abnormalities were noted on abdominal ultrasound examination.

DIFFERENTIAL DIAGNOSIS

The clinical signs of lethargy, tachycardia, presence of a significant heart murmur and jugular pulses would be consistent with cardiac disease. In particular, the presence of jugular pulses suggests significant tricuspid insufficiency and likely congestive heart failure. In this case, reduced cardiac output was due to valvular insufficiency that might have been related to congenital valvular formation or acquired deformity, with the latter commonly caused by an infection in ruminant species. Although no pyrexia was reported in this case, the presence of pleuritis and chronic low body condition score suggest a previous pneumonia with subsequent bacteraemia as a possible source of the endocarditis. The presence of a murmur is variable with valvular endocarditis and will depend on the extent of the valve deformity and functional impact of blood flow through the valve. When murmurs are present, they are due to turbulence of blood flow through a thickened valve. Although turbulent blood flow could have been picked up using an echocardiogram, this equipment is not readily available for on-farm use, and the procedure is not a common skill among first-opinion farm animal practitioners. Overall, the presenting clinical signs and thickened appearance of the tricuspid and mitral valves on ultrasound were diagnostic for valvular endocarditis and associated congestive heart failure.

OUTCOME AND FOLLOW-UP

Given the lethargy and cardiac findings of the case, the ewe lamb was euthanased with 60 ml pentobarbitone given intravenously (Pentoject 20%) and transported for gross post-mortem examination. On postmortem examination, there was focal, fibrinous effusion with pleural fibrosis and adhesions in the right hemithorax (Figure 1a), marked, vegetative endocarditis of the tricuspid valves (Figure 1b) with similar changes on the mitral valves (Figure 1c) and marked ascites. No samples were taken from the pleura or heart valves for bacteriological culture because of previous antibiotic therapy.

DISCUSSION

Valvular endocarditis is poorly reported in sheep, with previous case studies highlighting that the main clinical findings are often not specific to cardiac-related disease.⁷ Valvular endocarditis results in thickening of the heart valves that can lead

LEARNING POINTS/TAKE HOME MESSAGES

- Valvular endocarditis presents as irregular hyperechoic nodules allowing immediate diagnosis and euthanasia for welfare reasons, as there is no effective treatment.
- A portable ultrasound machine and 6.5 MHz microarray probe allows on-farm investigation and provides diagnostic quality sonograms of valvular endocarditis and lung pathology.
- On-farm rapid ultrasound examination of the ventral lung margins and heart can be undertaken within 1–2 minutes in the standing animal by an experienced practitioner.
- Ultrasound examination is a cost-effective diagnostic tool to differentiate lung and heart pathologies.
- Development of a repository of ultrasound recordings, as presented here, allows remote access via smartphones to support practitioners wishing to develop their ultrasonography skills.

to clinical signs associated with compromised cardiac output.⁸ Although commonly reported in cattle, jugular pulses have not been previously reported in sheep with endocarditis and might be missed where there is thick fleece coverage.⁴ Additionally, unlike bovine valvular endocarditis, heart murmurs are infrequently reported in ovine cases. When heart murmurs are present, as in this case, they tend to be severe (graded as 5/6 holosystolic) and consequently easily diagnosed on clinical examination.⁹ This highlights that when jugular pulses and heart murmurs are present, they are highly suggestive of valvular endocarditis; however, thoracic ultrasound could potentially be useful for diagnosing valvular endocarditis if specific clinical signs are absent.

As demonstrated in this case, thickening of the heart valves can readily be detected on ultrasound examination. The reliability of diagnostic techniques in cattle has been highlighted in various studies, with a meta-analysis of 460 cases of bovine bacterial endocarditis determining a sensitivity of 84.3% and a specificity of 92.7%.⁸ In our case, both mitral and tricuspid valves were affected by valvular endocarditis lesions. In cattle, the tricuspid valve is commonly affected as a result of bacteraemia with infection originating from another site in the animal's body.¹⁰ Although not specifically demonstrated in sheep, the pathogenesis is thought to be similar. In the authors' experience, by the time the animal is examined, multiple valves are affected. The findings in this case highlight that ultrasound examinations of both sides of the heart are important for confirmatory diagnosis. It is important to note that ultrasound examination does not always lead to the detection of lesions³ and therefore is no replacement for an initial thorough clinical examination of the animal.

Ultrasound examination can also be useful to investigate the potential predisposing factor that led to the development of valvular endocarditis. In this case, it is possible that the disease process that led to pleuritis in this ewe lamb also led to the development of valvular endocarditis. As mentioned, ovine case reports of valvular endocarditis have been

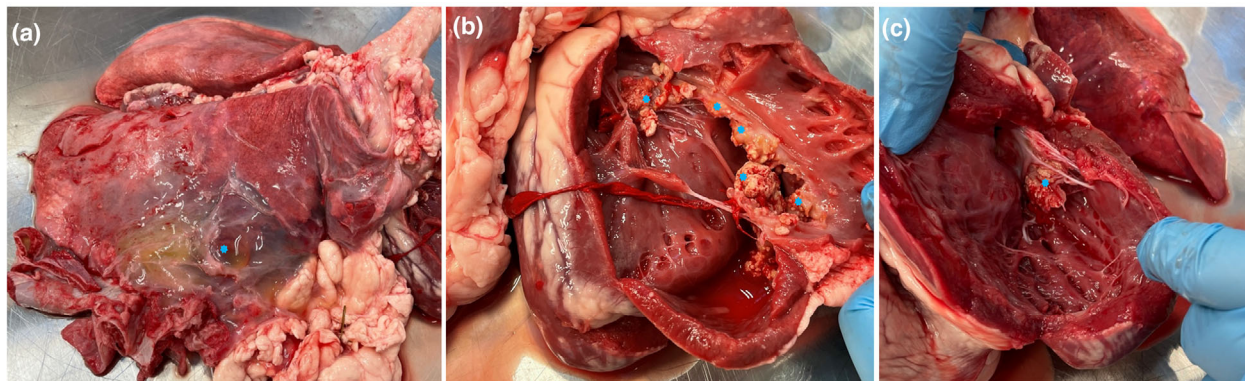


FIGURE 1 Thoracic pathology. (a) Lungs with fibrinous effusion, pleural fibrosis and adhered diaphragm (blue asterisk). (b) Right atrioventricular valve cusps with extensive vegetative endocarditis (blue asterisks). (c) Left atrioventricular valve cusps with extensive vegetative endocarditis (blue asterisk)

associated with a previous episode of bacteraemia as a consequence of previous pneumonia, mastitis, foot lameness, navel or joint illness.¹¹ The causal agent will depend on the nature of the previous disease process that led to the bacteraemia. Previous case studies report *Mannheimia haemolytica*, *Listeria monocytogenes* and *Erysipelothrix rhusiopathiae* as causal agents of valvular endocarditis in sheep.^{2,9,12} In cattle, the most common bacterial isolate is *Trueperella pyogenes*, with many other bacteria reported, especially *Streptococcus* spp.^{8–11} Microbiology is not helpful in antemortem diagnosis, as in the authors' experience isolates are rarely cultured and may not be specific to the predisposing condition. As the possible predisposing causes of bacteraemia commonly involve lesions that can often be detected on clinical examination, such as pneumonia or mastitis, ultrasound examination may be useful to diagnose potential causes. Understanding the causes could assist in future flock health planning to prevent the causes from occurring again in the future.

On-farm thoracic ultrasound examination is increasingly being used by sheep veterinary practitioners in the United Kingdom; for example, for further diagnosis of respiratory disease in individual animals and at the flock level, such as screening programmes for OPA, with scanning rates up to 150 sheep per hour achievable.¹³ While pericarditis and cardiac tumours are rare in sheep,³ vegetative endocarditis accounted for 4.5% of deaths in a knackery-based survey.¹⁴ This case report has demonstrated large valvular vegetative lesions, but this investigative technique can detect much smaller lesions (~0.5 mm in size). On-farm ultrasound examination in a standing sheep can take only 1–2 minutes for an experienced practitioner and up to 5 minutes for a less experienced practitioner. The ultrasound recordings presented here provide a useful archive that could be accessed via smartphone to support the less experienced on-farm veterinary practitioners. The continued development of an easily accessible online repository of livestock ultrasound recordings is important to allow farm animal veterinary surgeons to improve their ultrasound skills while in practice.

CONFLICTS OF INTEREST

The authors declare they have no conflicts of interest.

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ETHICS STATEMENT

The authors confirm that the ethical policies of the journal, as noted on the journal's author guidelines page, have been adhered to. No ethical approval was needed, as this is a single case report detailing a clinical case managed in keeping with the RCVS (Royal College of Veterinary Surgeons) professional guidelines.

AUTHOR CONTRIBUTIONS

PS, RK and ALC conducted the clinical workup of this case, including antemortem diagnostics. LM conducted the postmortem investigations. PS and RK conceived the draft proposal for the manuscript. RK and PS wrote the initial draft of the manuscript, with all authors contributing to the edits of the final draft.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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