Small Ruminant Research 92 (2010) 108–119

Contents lists available at ScienceDirect

Small Ruminant Research

journal homepage: www.elsevier.com/locate/smallrumres

Ultrasonography as an adjunct to clinical examination in sheep☆

P.R. Scott*, N.D. Sargison

Division of Veterinary Clinical Sciences, R(D)SVS, University of Edinburgh, Easter Bush, Roslin, Midlothian, EH25 9RG, Scotland, United Kingdom

ARTICLE INFO

Article history:
Available online 28 April 2010

Keywords:
Sheep
Ultrasonography
Diagnosis

ABSTRACT

Modern portable ultrasound machines provide the veterinary clinician with an inexpensive and non-invasive method to further examine sheep on farm which should take no more than 5 min with the results available immediately. Unlike radiography, ultrasonography presents no special health and safety procedures or restrictions. Fibrinous pleurisy, abscesses involving the pleurae and superficial lung, bronchopneumonia and the distribution of lung pathology caused by ovine pulmonary adenocarcinoma can be accurately outlined during ultrasonographic examination of the chest. Transabdominal ultrasonographic examination can readily identify distended bladder and uroperitoneum. Advanced hydronephrosis caused by obstructive urolithiasis is identified by the increased renal pelvis and thinned cortex. Unless caused by large numbers of migrating immature liver flukes, large accumulations of inflammatory exudate in the abdomen is uncommon in sheep. Ultrasonographic examination of palpable scrotal abnormalities can provide much useful information particularly in the diagnosis of epididymitis and testicular atrophy. Accurate diagnosis of foetal number has greatly improved the nutritional management of late gestation ewes.

1. Introduction

Many veterinarians in food animal practice routinely employ ultrasonographic examination using 5 MHz linear array scanners transrectally for the early detection, and possibly sexing, of bovine embryos. This equipment can also be employed to provide diagnostic quality ultrasound images of the ovine abdomen yielding immediate results. Examination of the chest necessitates use of a sector scanner. A recent clinical review of ovine respiratory disease adopted an aetiological approach (Bell, 2008a,b) with no critical evaluation of clinical examination criteria such as auscultation findings and ancillary aids such as radiography and ultrasonography. Cousens et al. (2008) reported no correlation between auscultation findings and the distribution of lesions of ovine pulmonary adenocarcinoma (OPA). These reports would indicate that ultrasonography is not widely used despite its many applications in the examination of the ovine respiratory system.

While ultrasonography has been successfully employed in commercial flocks for the past 30 years to determine foetal numbers and gestation stage permitting improved management during late gestation (Fowler and Wilkins, 1984; White et al., 1984; Russel, 1985), ultrasonographic examination can yield important clinical information of lesions within the chest (Scott and Gessert, 1998c), peritoneal cavity, liver (Scott et al., 2005), rumen, reticulum, abomasum (Scott et al., 1997b), bladder and kidney (Scott, 2000), uterus (Scott and Gessert, 2000) and joints (Macrae and Scott, 1999).

Practical examples that may have a major influence of flock management and disease prevalence include determination of abomasal size in neonates, which provides the veterinarian with immediate on-farm information relating to colostrum ingestion by newborn lambs (Scott et al.,

☆ This paper is part of the special issue entitled: Sheep diagnostic medicine, Guest-edited by G.C. Fthenakis, P.G. Gouletsou, V.S. Mavrogianni and I.A. Fragkou.

* Corresponding author.
E-mail address: Philip.r.scott@ed.ac.uk (P.R. Scott).

0921-4488/$ – see front matter © 2010 Elsevier B.V. All rights reserved.
doi:10.1016/j.smallrumres.2010.04.011

1997b). Ultrasound examination of vaginal prolapse has produced a more effective method for replacement when the urinary bladder is contained within the prolapsed tissues (Scott and Gessert, 1998a,b). On-farm identification of urinary tract obstruction (Scott, 2000) enables immediate action without recourse to laboratory testing and further delays that adversely influence prognosis.

2. Ultrasonographic examination—equipment

A 5.0 MHz linear transducer connected to a real-time B-mode ultrasound machine can be used for all ultrasonographic examinations except examination of the chest, liver and right kidney, where a 5.0 MHz sector transducer is necessary to ensure good contact between the convex intercostal spaces and the concave flank of the right sublumbar fossa, respectively. The field setting of 10 cm on the linear scanner is appropriate for most abdominal examinations; occasionally the 20 cm field depth afforded by certain 5.0 MHz sector scanners determines more accurately the extent of fluid accumulation and bladder diametre, but this does not significantly alter the clinical diagnosis. Transrectal examination of the bladder and kidney has been reported in both rams and ewes (Braun et al., 1992a,b), but this examination has not proved necessary to determine obstructive urolithiasis in practice. Examination of the entire liver may necessitate use of a 3.5 MHz convex transducer, but results in loss of definition and image quality.

3. Sites for ultrasonographic examination

3.1. Chest

A 5.0 MHz sector transducer connected to a real-time B-mode ultrasound machine is used for the ultrasonographic examination of the chest. An initial field setting of 6–7 cm allows detailed examination of the pleurae and superficial lung parenchyma which can be subsequently increased to 12–16 cm to examine the full extent of any lesions. A 5 cm wide strip of fleece is quickly shaved from both sides of the thorax extending vertically from the point of the elbow. The skin is soaked with warm tap water, then ultrasound gel is liberally applied to the wet skin to ensure good contact. The transducer head is firmly held against the skin overlying the intercostal muscles of the 6th or 7th intercostal spaces and the thorax examined in both longitudinal and transverse planes. The dorsal lung field is selected at the start of all ultrasound examinations in an attempt to visualise normal lung tissue as this area is much less commonly affected in ovine respiratory disease.

3.2. Liver

The liver can be imaged from the 9th to 11th intercostal spaces, halfway down the right chest wall and sometimes immediately caudal to the costal arch at this level with the 5 MHz sector probe head pointed towards the contralateral shoulder. Examination using a 3.5 MHz convex transducer results in loss of definition and image quality.

3.3. Bladder, uterus, vagina, and ventral abdomen

The absence of fleece in the ventral midline and inguinal area expedites preparation when examining the ventral and caudal abdomen in sheep. Ultrasonographic examinations of the bladder and caudal abdomen are undertaken in the standing animal using either 5.0 MHz linear array or sector scanners (often have different depths of field). The caudal abdomen is examined for the bladder and gravid uterus. The right inguinal region immediately cranial to the pubis is cleaned using a mild detergent solution diluted in warm tap water to remove superficial grease and debris. The right inguinal region is chosen because the left side of the abdomen is largely occupied by the rumen. Ultrasound gel is liberally applied to the wet skin to ensure good contact. The transducer head is firmly held at right angles against the abdominal wall. If the bladder is enlarged, an estimate of its size can be obtained by moving the 5.0 MHz linear scanner (field depth of 10 cm) cranially along the ventral midline from the level of the pubic symphysis because of its cylindrical rather than spherical shape when distended. The posterior reproductive tract can be imaged by directing the sector transducer towards the tail head from a midline position immediately cranial to the pubic symphysis.

3.4. Right kidney

Examination of the right kidney necessitates shaving the fleece from an area of the right sublumbar fossa immediately caudal to the last rib. The sector transducer head is firmly held against the skin to ensure good visualisation of the right kidney juxtaposed the caudal lobe of the liver.

3.5. Abomasal diametre of neonatal lambs

The abomasal diametre of neonatal lambs can be measured using a 5 MHz sector scanner applied at right angles to the abdominal wall at the umbilicus. The abomasum can be clearly identified as a hypoechoic area delineated by a hyperechoic wall. The vertical distance is measured between the probe head and the far abomasal wall.

3.6. Vaginal prolapse

The contents of the vaginal prolapse can be readily determined using real-time B-mode ultrasonography with a 5 MHz transducer and either linear array or sector scanners.

3.7. Scrotum

Sequential examination of the *pampiniform plexus*, testis and tail of the epididymis is undertaken as a sector or linear array transducer of 5–7 MHz scanner is moved distally over the lateral aspect of each spermatic cord, testis and tail of the epididymis (Gouletsou et al., 2003).

3.8. Joints

Ultrasonography using a 7.5 MHz linear array scanner with a stand-off can provide some additional useful