On-farm ultrasound uses:
Beyond pregnancy diagnosis
Clinical booklet with Easi-Scan
This Clinical Booklet has been designed by BCF Technology Ltd as a reference guide to demonstrate additional on-farm uses of ultrasound through the use of text description, photos and ultrasound images.

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Contents

Scanning preparation 2
Choosing scan mode 3
Udder 4
Teat 6
Thorax 8
Gastrointestinal tract 10
Abdominal organs 12
Subcutaneous lesions 14
Umbilical region 16
Musculoskeletal 18
Testicle 20
Small animal 22
References 24

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Ultrasound is commonly used in farm animals as a method of pregnancy diagnosis and to evaluate the female reproductive tract for changes. This evaluation will impact the management of an individual animal, such as the presence of a follicular or luteal cyst on the ovary. In addition to these applications, ultrasound can also be a diagnostic tool to investigate many other conditions which are seen on-farm. Some examples include traumatic reticuloperitonitis, LDA, umbilical hernia and teat stenosis.

It is essential that ultrasound findings are considered in conjunction with all other diagnostic information including:

- History of the presenting condition
- Response to any administered treatments
- Clinical examination findings (visual assessment, auscultation, palpation, rectal temperature, etc.)
- Hematology, biochemistry, and/or metabolic profile results.

It is also important to perform an evaluation of potential environmental factors which may impact development of disease on an individual animal, herd or flock.

The aim of this booklet is to provide an introduction into how you can further integrate ultrasound into your on-farm investigation of disease. It will also highlight conditions where ultrasound use may be of particular value from an economic, animal health, or welfare perspective. Each section will contain a description of scanning technique, a brief description of normal ultrasound anatomy and a discussion on clinical conditions which may be identified using ultrasound. Specific case examples are used where appropriate.
Scanning preparation

Here are a few tips to help you get started:

- Animals to be scanned must be adequately restrained

- Appropriate preparation of the region to be scanned is important to ensure the highest possible diagnostic quality of the ultrasound image. Unless specifically indicated throughout the text, the following steps should be followed:

  1) Clip the haircoat as close to the skin as possible

  2) Apply warm water to the clipped area to soak the skin

  3) Liberally apply ultrasound coupling gel to the area – OB lube is too watery and will not be as effective at providing the necessary contact between the probe and the skin.

💡 Allowing the gel at least five minutes to soak in before you get started scanning makes a significant difference.

- Apply appropriate pressure to the ultrasound probe to ensure good contact is achieved.

- Ultrasound machine controls should be altered according to the region being scanned, including depth, frequency, focus and gain.
Choosing scan mode

In addition to changing depth, the various modes also alter the degree of contrast seen in the displayed image, resulting in tissues appearing more grey or more black/white. The appropriate mode should be selected according to species, thickness of body part, scanning approach/use of standoff (see teat section) and amount of natural tissue contrast in the region being scanned. Once the probe is placed on the animal, the various modes should be tried to determine which is most effective.

Easi-Scan mode depths

On the Easi-Scan, changing the mode between ovary/early, late, foetal sexing and detail will alter the depth, frequency and focus. You can adjust the gain (brightness) independently.

- Detail – 6 cm
- Ovary/Early – 8 cm
- Foetal sexing – 8 cm with more focus on the top 4 cm of the screen
- Late – 12 cm
- Detail – 4 cm (available with Easi-Scan Smart Display only)
Udder

Ultrasonography of the udder can provide additional diagnostic information regarding the udder parenchyma.

How to scan

Each quarter of the udder should be examined in a systematic manner. The probe should be positioned in both proximal-distal and cranial-caudal orientations and moved along the surface of each quarter to enable the entire gland to be evaluated (see Figure 1 for technique).

Normal anatomy

As shown in Figure 2, the parenchyma of the udder should be relatively homogenous with visualisation of milk ducts and blood vessels throughout. The degree of distension of the milk ducts will vary in relation to time of milking.

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Pathology

Ultrasound may be used to investigate cases of udder enlargement which present without clinical signs of mastitis, such as hematomas, edema, and abscess formation which does not involve the milk producing tissue. In mastitis cases, the ultrasound image of the affected gland may demonstrate abnormalities which have been associated with specific causative agents.

Figure 3 is an ultrasound image of a bovine udder affected with mastitis caused by *Trueperella pyogenes*. This is characterised by the presence of multiple, hypoechoic regions throughout the parenchyma. Bacterial milk culture confirmed the causative agent.

Why ultrasound?

Ultrasonography of the udder can be a useful adjunct to more commonly used diagnostic tests for the evaluation of udder health such as visual inspection of the udder and milk, udder palpation, somatic cell count evaluation and bacteriological culture of milk samples.
Teat

Abnormalities of the teat can have a significant effect on the productivity of individual animals within a herd/flock. In particular, stenosis of the teat can result in a reduction in milk flow impeding efficient milking and also a greater susceptibility to the development of mastitis.

How to scan

As the teat is not a rigid structure, the ultrasound probe should be applied in a manner that does not significantly distort the shape of the teat. There are two methods for achieving this:

1) Apply the ultrasound probe directly to the teat surface. When imaging the teat/gland junction, an appropriate degree of pressure should be applied to achieve adequate contact but not distort the teat shape.

2) Utilise a ‘standoff’. This technique may improve visualisation of the most superficial region of the teat (directly below the surface of the probe) and the tip of the teat. Ultrasound coupling gel should be applied to all surfaces to improve contact between the probe and ‘standoff’.

A ‘standoff’, whether purchased or homemade, is an object positioned between the area being scanned and the surface of the probe. It can be a cup or glove filled with water where the teat is submerged.
**Normal anatomy**

The teat wall is comprised of five layers. Due to their ultrasonographic appearance, they may be grouped into three distinct layers. Milk within the lumen of the normal teat cistern appears anechoic on the ultrasound image. As seen in Figure 3 the three distinct layers are:

1) Inner mucosal layer (teat lining)
2) Middle layer of connective tissue, muscle, nerves and blood vessels
3) Outer layer of skin.

**Pathology**

Figure 4 is an image of a diagnosed case of stenosis/fibrosis of the teat cistern, a common abnormality of the teat. The shape of the teat cistern is distorted and there are hyperechoic strands of material present within the teat cistern, representing fibrosis within the teat lumen. This condition was not grossly apparent externally. Refer to Figure 2 for normal appearance.

**Why ultrasound?**

Ultrasound may be a useful tool for further investigating the presence and extent of abnormalities affecting the teat. The primary benefit is that various abnormalities of the teat and the teat/gland junction, which can be missed if not grossly evident externally or upon palpation, may be visualised with ultrasound.
**Thorax**

Ultrasonography of the thorax may enable the pleural surface of the lung and superficial lung parenchyma, heart and mediastinal region to be evaluated. This is dependent on the species being examined, animal size and approach utilised.

**How to scan**

When evaluating the lung and pleural surface, the probe is initially placed in the intercostal space immediately caudal to the point of the elbow and moved along the intercostal space in the dorsoventral direction (parallel to the ribs). See Figures 1 and 2 for probe placement in cattle and sheep.

Evaluation of the heart and pericardial space may be achieved in some animals, particularly cattle which are in a thin body condition and sheep.

Pulling the leg forward can be helpful to reposition the location of the triceps muscle mass, allowing the probe to be placed further ventrally and cranially to overly the cardiac region. The mediastinal space may also be visualised by placing the probe in the region of the thoracic inlet and directed caudally.

**Normal description**

The presence of air within the normal lung prevents the ultrasound waves from penetrating deeply into the lung parenchyma. Therefore, the highly reflective pleural surface which is in contact with aerated lung is readily identified on ultrasound as a uniformly hyperechoic line which moves in synch with respiration. Figure 3 shows the
surface of the lung in a normal cow with no evidence of pulmonary disease.

Pathology

Conditions such as bovine respiratory disease (BRD)/chronic suppurative pulmonary disease (CSPD) have a significant impact on health and productivity of both beef and dairy cattle. Ultrasound may be utilised in conjunction with clinical examination findings, including demeanor, feed intake, rectal temperature, thoracic auscultation, and presence of coughing and nasal discharge to further evaluate the lungs for presence and distribution of lesions.

Figure 4 shows a sheep with fibrinous pleuritis. This is visualised as the presence of hypoechoic fluid within the thoracic cavity containing strands/aggregates of more hyperechoic material.

Why ultrasound?

Ultrasound may be used to identify abnormalities such as pleural effusion, septic pericarditis, lung lobe consolidation, ovine pulmonary adenocarcinoma and fibrinous pleuritis, as previously demonstrated.

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Gastrointestinal tract

Evaluation of the gastrointestinal (GI) tract in cattle using ultrasound may be useful to assist in diagnosing the underlying cause of GI dysfunction and determine the most appropriate course of action to pursue.

How to scan

The location of probe placement on the animal will depend on the portion of the GI tract being investigated.

Where there is a significant amount of gas within a particular portion of the GI tract, such as the reticulum and dorsal gas cap of the rumen, only the gastrointestinal wall nearest to the probe may be visualised.

Normal anatomy

The wall of the rumen will normally appear as a hyperechoic line with visualisation of the rumen contents dependent on which region of the rumen is being scanned. Figure 2 demonstrates the normal ultrasound appearance of the dorsal gas cap of the rumen with spleen present cranially.
Pathology

Positive identification of gastrointestinal disorders in farm animals can be diagnostically challenging, particularly those presenting with non-specific clinical signs such as a decrease in milk yield or abdominal pain.

Figure 3 shows an ultrasound image of a cow with traumatic reticuloperitonitis. There is evidence of fluid accumulation and fibrinous deposits ventrally in the region between the reticulum and the craniodorsal blind sac of the rumen. This cow presented with an 18-month history of poor milk yield and gradual loss of body condition.

Why ultrasound?

Historical information and clinical examination findings, as well as results of diagnostic tests such as abdominocentesis and serum biochemistry are useful, but may not enable confirmation of a suspected diagnosis to be reliably made in all cases. Traumatic reticuloperitonitis, displaced abomasum and ileus of the small intestine may be identified using ultrasound as the structures involved may be visualised and evaluated for the presence of abnormalities.

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Abdominal organs

Accurate diagnosis of the underlying cause of diseases in farm animals presenting with non-specific clinical signs such as pyrexia and abdominal pain can be challenging. Ultrasound can be a useful adjunctive tool for evaluating the abdominal organs for evidence of disease.

How to scan

The liver, kidneys and spleen may be visualised by using a transabdominal approach by placing the probe in direct contact with the skin in the region of the organ of interest. Due to the variation in size and anatomical location of these organs in various species, it may not be possible to thoroughly examine the entire organ in every animal. Figure 1 shows probe placement for evaluation of a longitudinal section of the right kidney in the cow.

The probe should be rotated and moved along the surface of the skin in both the dorsal-ventral and cranial-caudal directions to allow the organ to be assessed in a systematic manner.

Normal anatomy

The bovine liver lies directly medial to the right body wall, and may be readily visualised in the 10th–12th intercostal spaces. The parenchyma of the normal bovine liver appears coarsely granular and moderately echogenic on ultrasound examination. The hepatic and portal veins may be observed as anechoic, tubular structures distributed throughout the hepatic parenchyma as shown in Figure 2. The bile ducts are usually only
apparent ultrasonographically within the liver when there is evidence of biliary stasis or when ducts have calcified.

Ultrasound examination of the normal bovine kidney will demonstrate both the cortex and the medulla. Figure 3 shows the ultrasound appearance of the cranial pole of a normal bovine kidney in the longitudinal plane.

**Pathology**

Conditions which may be further investigated through the use of ultrasound include pyelonephritis, hydronephrosis, renal cysts, liver abscesses, fascioliasis and other causes of biliary tract alterations. Changes associated with metabolic disturbances, such as fatty liver can also be evaluated.

**Why ultrasound?**

Ultrasonography of the abdominal viscera enables these organs to be evaluated for changes in size, shape and echogenicity. This information may be useful for determining the most appropriate course of action in conditions such as pyelonephritis, where identification of disease in only one kidney will enable the decision to perform a unilateral nephrectomy to be made with a greater degree of confidence.
Subcutaneous lesions

Subcutaneous lesions or swellings may be of little interest if the animal does not express signs of pain and discomfort or a decline in productivity. However, the location and distribution of lesions may indicate an underlying systemic disease or management issue requiring attention.

How to scan

The probe should be placed in contact with the skin overlying the lesion, ensuring good contact is achieved through application of gel and appropriate pressure to the probe. Remember that applying too much pressure may distort the appearance of the lesion, particularly if the swelling is very soft or fluid filled.

It is helpful to not only scan the apparent lesion, but also the ‘normal’ surrounding regions. This will allow the lesion margins to be identified and the true extent to be determined.

Normal anatomy

The thickness and composition of tissue in the subcutaneous region will vary among individuals and according to location on the body. Figure 2 shows a regular arrangement and consistent thickness of the subcutaneous tissues.
Pathology

The ultrasound image in Figure 3 demonstrates a thickening of the subcutaneous tissues in this region with a mixed echogenic appearance. This is an injection site abscess that has been present for approximately one week.

Common subcutaneous lesions amongst farm animals include:

- hematomas
- abscesses
- edema
- hygromas and others.

Why ultrasound?

With ultrasound you can determine the nature of the lesion prior to initial treatment. This is beneficial from a financial and welfare perspective as your diagnosis will aid in initially selecting the appropriate treatment.
Umbilical region

The region of the umbilicus contains various structures including the umbilical vessels, urachus and surrounding structures such as the body wall.

How to scan

The ultrasound probe should be placed directly in contact with the swelling in the umbilical region and the surrounding tissues should also be examined.

Particular attention should be paid to the junction between the body wall and the swelling to identify any defect in the body wall.

Normal anatomy

The ultrasound image taken from the region of the umbilicus should be similar to that of the surrounding tissues without evidence of abnormal swelling.

Pathology

Abnormalities of the umbilical region are commonly encountered in farm animal species. The most common causes of swellings affecting the umbilical region are infections of umbilical structures (urachus, umbilical vessels) with possible abscess formation, umbilical hernias or a combination of both.

Figure 1 shows a cow with chronic swelling in the umbilical region. This has been present from 1 week of age and
size frequently fluctuates. Figure 2 is the ultrasound image of this swelling. There is a discrete structure containing echogenic material located external to the body wall with a thickened wall/capsule, indicative of a chronic abscess. There is no evidence of communication between the swelling and the peritoneal cavity through a defect in the body wall and no loops of intestine are observed within the swelling.

**Why ultrasound?**

Ultrasound may be used to gather information regarding the internal structure and contents of a swelling in the umbilical region which will assist in the decision making process regarding treatment options and prognosis. In conjunction with palpation of the region to determine if the swelling is reducible, ultrasound will allow the identification of intestinal loops within a hernial sac and possibly provide visualisation of the deficit in the body wall.
Musculoskeletal

Lameness in farm animal species, particularly dairy cattle, is an important issue that impacts productivity and animal welfare. Evaluation of an animal presenting with lameness involves gait observation, physical examination, and evaluation of the farm environment.

How to scan

The probe should be placed firmly in contact with the skin surface overlying the region of interest. Figure 1 shows the technique while scanning the lateral aspect of the hock.

Achieving good contact can be challenging when scanning over bony prominences, so use plenty of gel and rotate or slide the probe along the area to obtain the most useful view.

A standoff, such as a latex glove filled with water and placed between the probe and the skin surface, may be helpful.

Normal anatomy

A normal ultrasound appearance for the bovine hock demonstrates a minimal amount of soft tissue overlying the bony prominences in this region.

Pathology

Ultrasound can be a useful adjunctive tool when evaluating a lameness case, particularly if the presentation or lesion distribution is unusual or the lameness has proven refractory to conventional therapies. Structures which may be evaluated include
tendons, ligaments, muscle, cortical surfaces of bone and joint margins.

Figure 2 shows a dairy cow with chronic lameness in the right hindlimb. There is a soft tissue swelling on the lateral aspect of the right hock. The lameness had not improved despite several courses of antimicrobial treatment.

Figure 3 is the ultrasound image of the soft tissue swelling from Figure 2. The anechoic center of the lesion and the more echogenic, thickened capsule is consistent with chronic tarsal cellulitis. The location of this lesion is in the tarsocrural joint region; an association between the joint and lesion can be observed. Due to the degree of lameness, ultrasonographic appearance, and poor response to therapy; prognosis for response to further treatment and full return to normal mobility is poor.

**Why ultrasound?**

The use of ultrasound to further investigate the nature and extent of suspect lesions can provide information which may assist in the selection of the most appropriate course of therapy as well as provide an insight into likely prognosis for return to function of that limb.

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**Testicle**

Investigation of poor fertility within the herd or flock must include evaluation of the reproductive tract in both males and females. A breeding soundness exam should be performed where a natural service bull or ram is used for breeding.

**How to scan**

Systematically evaluate the scrotal contents by orientating the probe in a proximal to distal direction with the tip of the probe initially in the region of the spermatic cord. The probe is then moved along the scrotum in the longitudinal plane to evaluate the pampiniform plexus, epididymis and testicle as seen in Figure 1. The structures should also be evaluated in the transverse plane to maximise the likelihood of identifying pathologic lesions.

**Normal anatomy**

In figure 2, the testicular parenchyma has a homogenous echotexture with the mediastinum testis present as a hyperechoic line. The anechoic, tubular, vascular structures of the pampiniform plexus are also visualised. The epididymis is not present in this image.
Pathology

Abnormalities of the testicle, epididymis and other scrotal contents which may be identified or investigated further with ultrasound include epididymitis/epididymal cyst formation, testicular atrophy/degeneration, neoplasia, varicocele and testicular torsion.

In Figure 3, multiple hyperechoic foci with distal acoustic shadowing throughout the testicular parenchyma can be seen. These represent degeneration and mineralisation of the seminiferous tubules in this infertile ram.

Why ultrasound?

Ultrasonography of the testicle may be particularly informative when palpation of the scrotal contents is unrewarding. Visual inspections, palpation of reproductive structures and semen sample evaluations are common methods for determining reproductive health. Ultrasound examination of the scrotum and its contents can provide additional information not detectable by other methods.
Small animal

Several conditions that can be readily investigated on farm include – pyometra, pregnancy, abdominal masses, pericardial or pleural effusion, poor cardiac contractility (as seen in cases of dilated cardiomyopathy, DCM), and urinary bladder lesions. An ultrasound machine can also be an extremely useful tool when presented with an ill working dog or farm cat for pregnancy diagnosis.

How to scan

Achieving adequate contact for the region of interest can prove to be a slight challenge due to the size and shape of the linear rectal probe. Place the probe in the region of interest and rotate the probe to evaluate all structures in both the longitudinal and transverse planes.

Figure 1 shows the initial probe placement for evaluating structures in the cranial abdomen, including the liver, stomach and spleen.

Normal anatomy

Figure 2 is an ultrasound image of the normal canine spleen and colon. The spleen has a homogenous, moderately echogenic appearance with a smooth margin/capsule. Due to the amount of gas present within the lumen of the colon, only the wall nearest the probe is visualised and appears as a hyperechoic line.

Pathology

The echogenicity of the spleen parenchyma is homogenous with visualisation of anechoic blood
vessels in the region of the hilus. Where present, clinical conditions affecting abdominal organs, such as splenic hemangiosarcoma +/- ascites may be readily identified on ultrasound examination. Example:

- Fluid distension of the peritoneal cavity will appear as anechoic/hyperechoic material surrounding the abdominal viscera
- Neoplasia affecting the spleen may appear as solitary or multifocal lesions which alter the normal echogenicity and shape/margination of the spleen.

The echogenic mitral valve leaflets may be identified as well as the left atrium and ventricle. Where gross pathologic changes are present, ultrasound examination of the heart can enable an on-farm diagnosis (Figure 3). In cases of degenerative valvular disease, the leaflets of the atrioventricular valve may appear thickened and appear to not fully meet, suggesting valvular incompetence. Dilation of the left atrium, which is useful as a prognostic indicator, may also be appreciated if present.

**Why ultrasound**

As noted above, many working diagnoses in small animals can be made on-farm utilising the ultrasound machine. Ultrasound can provide answers when other diagnostic tests are not available or practical for performing on-farm.

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References


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