Improving bovine reproductive management with ultrasound

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During this time of economic downturn, veterinary practitioners and farmers must show initiative and innovation to improve efficiency and therefore remain profitable. Ultrasonography is one such innovation for use in bovine reproductive management. Ultrasound and manual palpation are the most popular methods used for reproductive management. This article will discuss the advantages of ultrasound over manual palpation for improving management of the dairy herd.

ABSTRACT
Ultrasound examination of the bovine reproductive tract is a valuable tool for use in cattle herd management. This article compares the use of transrectal ultrasonography with manual palpation for the evaluation of the bovine reproductive tract. Ultrasound offers a number of advantages over manual palpation including earlier, more accurate identification of non-pregnant cows, confirmation of foetal viability, accurate identification of twins, determination of foetal gender and accurate evaluation of ovarian and uterine structures. Therefore, the effective use of ultrasound in herd management programmes may significantly improve reproductive efficiency and overall profitability.

HOW ULTRASOUND WORKS
In diagnostic ultrasonography, ultrasound waves are produced by electrical stimulation of crystals within the transducer (probe). As these waves encounter an interface between tissues of varying density, a proportion of the waves are reflected, while the rest continue travelling into deeper tissues. The reflected waves (echoes) return to the transducer where the strength of each echo is recorded and displayed on the screen as varying degrees of echogenicity or ‘brightness’. Strong reflective echoes, created by an
encounter with a dense tissue such as bone, appear white. Weaker echoes, resulting from transmission through fluid, appear black. Ultrasound images produced from imaging soft tissue structures of intermediate density appear as varying shades of gray.

**BENEFITS OF ULTRASOUND**

Experienced clinicians may become very proficient in evaluation of the reproductive tract through manual palpation. However, the use of transrectal ultrasonography by the bovine practitioner enables the architecture of the ovaries, uterus, reproductive vasculature and surrounding structures to be visualised and evaluated.

Ultrasound is the most effective diagnostic tool available for use in reproductive management of the herd. The advantages of ultrasound are:

- Earlier, more accurate identification of non-pregnant cows;
- Confirmation of foetal viability;
- Accurate identification of twins;
- Foetal gender determination; and,
- Accurate evaluation of ovarian and uterine structures.

**EARLY PREGNANCY DETECTION**

Early and accurate identification of the non-pregnant cow is essential to improve the overall reproductive status of the herd. Cows which are identified as non-pregnant may be re-bred more quickly which improves overall fertility rates and thus profitability.

Most practitioners can diagnose pregnancy quickly, easily and accurately through the use of transrectal ultrasonography. Under most on-farm conditions, pregnancy can be diagnosed as early as 26 days post artificial insemination (AI) (Filteau and DesCôteaux, 1998). This is approximately seven days earlier than pregnancy diagnosis by manual palpation according to a survey by Rosenbaum and Warnick (2004). However, diagnosis of pregnancy at an early stage should be considered with caution due to the possibility of early embryonic loss.

**FOETAL VIABILITY**

It is important to confirm foetal viability following early pregnancy diagnosis with repeated ultrasound examination. Published rates of embryonic/foetal death in the first two months of pregnancy are variable and depend on the individual study. However, rates range from 10-25% in adult dairy cows. This represents a significant factor affecting overall reproductive performance of the dairy herd. Several indicators of foetal death can be identified through the use of ultrasound, including (Colloton and Stroud, 2009):

- Lack of foetal heartbeat/foetal movement;
- Presence of flocculent material in the amniotic or chorioallantoic fluid; and,
- Separation of the chorioallantois from the uterine wall.

Early detection of embryonic/foetal death will decrease the time to re-breeding of the non-pregnant cow and therefore improve profitability.

**DETECTING TWINS**

The development of twin pregnancies in dairy cattle is undesirable due to the resultant reduction in overall herd reproductive efficiency and therefore farm profitability. Twinning in cows may result in higher rates of embryonic death and late-term abortion, premature and/or difficult calving and the development of various metabolic diseases such as ketosis. The management protocol for twin pregnancies will vary between farms and may include culling, abortion and re-breeding, or continued management until parturition (Fricke, 2001). Therefore, early identification of a cow carrying twins is important to minimise potential costs to the farm. Ultrasound is an effective tool as twin pregnancies can be accurately identified using transrectal ultrasonography by 40-70 days post breeding/AI (Day et al., 1995; Echternkamp and Gregory, 1999).

**FOETAL SEXING**

Transrectal ultrasonography is useful for determining foetal sex by evaluating the morphology and location of the genital tubercle (precursor to the penis and clitoris). The bovine practitioner may use ultrasound to accurately determine foetal sex from day 55-60 post ovulation (Curran et al., 1989; Müller and Wittkowski, 1986). Accurate identification of foetal sex may be useful for dairy herd management programmes, particularly if used to determine predicted numbers of replacement heifer calves.

**OVARIAN AND UTERINE STRUCTURES**

Ultrasound is the most effective method of assessing ovarian structures. Through the use of ultrasound, bovine practitioners can assess various ovarian and uterine structures including follicles, corpora lutea, cystic structures, both follicular and luteal in nature, uterine horns and uterine body. When ultrasound findings are considered in combination with farm records, herd data, visual observation (i.e. observation of oestrus or ‘heat’) and manual palpation findings, the reproductive status of each individual cow may be determined. As a result, overall reproductive management of the herd is improved and profitability is increased.
It is essential to breed cows at the appropriate stage of the oestrous cycle in order to improve overall herd fertility rates. Evaluation of the appearance of ovarian follicles, corpora lutea and the uterus on repeated ultrasound examinations can aid the bovine practitioner in determining the stage of the oestrous cycle. Ultrasound examination of the reproductive tract of a cow in the pre-ovulatory period will generally show prominence of the endometrial folds due to uterine oedema, accumulation of mucus in the uterine lumen and presence of a pre-ovulatory follicle. Based on this information, the timing of artificial insemination can be optimised (Boyd and Omran, 1991).

Ultrasound is also useful in investigating members of the herd with poor fertility due to cyclic abnormalities or pathologic conditions affecting the ovaries and/or uterus. Conditions affecting fertility such as metritis/pyometra and cystic ovarian disease can be accurately identified and treated appropriately (Edmondson et al., 1986; Fissore et al., 1986).

ECONOMICS OF ULTRASOUND

The economic value of ultrasound to a bovine reproductive management programme depends on multiple factors. These factors may include:

- Speed of ultrasound examination;
- Accurate identification of stage of the cycle for timed AI;
- Accurate identification of the non-pregnant cow;
- Rapid re-breeding of non-pregnant cows;
- Accurate diagnosis of ovarian and uterine abnormalities;
- Use of appropriate treatment for ovarian and uterine abnormalities; and,
- Cost per ultrasound examination (individual practice variation).

Many of these factors are dependent on the individual ultrasound operator so, as experience and skill level improve, the economic value of ultrasound for use in bovine reproduction will likely also increase.

CHOOSING AN ULTRASOUND MACHINE

The purchase of ultrasound equipment represents a significant investment. Factors to consider when buying a machine include:

- Ability of machine to withstand the working environment (water resistant, durable);
- Portability;
- Power source (A/C versus Battery);
- Ease of use;
- Purchase price; and,
- Maintenance costs.

It is also important to consider the services provided by the ultrasound equipment supplier such as customer support, maintenance/repair services and ultrasound training programmes offered.

REFERENCES

CONTINUING EDUCATION: READER QUESTIONS AND ANSWERS

1. **ECHOES ARE PRODUCED BY THE REFLECTION OF ULTRASOUND WAVES AT THE INTERFACE OF TISSUES WITH VARYING:**
   - a) Length
   - b) Width
   - c) Density
   - d) Colour
   - e) Volume

2. **THE USE OF ULTRASOUND ENABLES PREGNANCY TO BE DETECTED APPROXIMATELY ___ DAYS EARLIER THAN BY MANUAL PALPATION.**
   - a) 4
   - b) 7
   - c) 10
   - d) 11
   - e) 12

3. **THE NEGATIVE EFFECTS OF TWIN PREGNANCY ON REPRODUCTIVE EFFICIENCY OF THE DAIRY HERD INCLUDE:**
   - a) Higher rates of embryonic death
   - b) Increased incidence of dystocia
   - c) Increased incidence of metabolic disorders
   - d) All of the above
   - e) None of the above

4. **WHICH OF THE FOLLOWING CANNOT BE ASSESSED THROUGH THE USE OF TRANSRECTAL ULTRASONOGRAPHY:**
   - a) Ovarian follicles
   - b) Presence of corpora lutea
   - c) Intra-luminal uterine mucus
   - d) Foetal sex at day 26 post-ovulation
   - e) Foetal heartbeat

5. **WHAT IS THE ARROWED STRUCTURE?**
   - a) Umbilicus
   - b) Foetal head
   - c) Foetal trunk
   - d) Foetal heart
   - e) Genital tubercle

6. **WHEN CHOOSING AN ULTRASOUND MACHINE, IT IS IMPORTANT TO CONSIDER ALL OF THE FOLLOWING EXCEPT:**
   - a) Breed of cow
   - b) Portability
   - c) Power source
   - d) Durability
   - e) Ease of use

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