Diagnostic Imaging

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The Evolution of Bovine Reproductive Ultrasound and the Role of Veterinarians

Jill Colloton.

Bovine Services, Edgar, USA.

Objectives: The objective of this presentation is to review the parallel evolution of reproductive management of cattle and the use of ultrasound as a diagnostic tool since 1995, to consider possible future developments, and to encourage veterinarians to be the primary providers of ultrasound diagnostic services.

Materials and methods: Historical documents and personal experience in practice were compiled to present a timeline of the evolution of management and diagnostic methods for bovine reproduction. Current research was reviewed to understand possible future developments.

Client interviews were utilized to understand the producer's perspective in choosing a provider for diagnosis and consultation regarding the reproductive health programs on their farms.

Results: Parallel advances in the management and diagnosis of bovine reproductive health over the last 30 years have driven the need for skilled consultants and diagnosticians. Producers recognize that their veterinarians are uniquely suited to understand the current science and best provide these services. They also feel their veterinarian is more cost effective and reliable than hiring a technician or training a farm employee.

Conclusions: As the capabilities of ultrasound technology and our knowledge of bovine reproductive management evolve veterinarians are uniquely equipped to provide the best service for producers.

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The Doppler in field reproductive management: effective resource or pure fantasy?

Giovanni Gnemmi.

BOVINEVET INTERNACIONAL Bovine Ultrasound Services & Herd Management, Huesca, Spain.

Objectives: Is the Doppler a technique that we can use on a daily basis in dairy/beef farms? Is Doppler a technique that only has a reason to be used in research?

Can we use Doppler for the diagnosis of non-pregnancy in cattle? Are there differences between dairy and beef cattle? When is it convenient to perform this examination?

Can we use Doppler for the selection of recipients in embryo transfer?

Is it possible to use Doppler to define the time of ovulation?

Is it possible to use the Doppler to define the time of the oestrus cycle?

Is it difficult to learn to use Doppler? Is it difficult to set up the ultrasound scanner to use the Doppler? Is it convenient to buy an ultrasound scanner with Doppler?

Can I use Doppler to define the physio-pathology of the uterus?

Can I use the Doppler to make a diagnosis of embryonic distress and/or can I use this technique to define possible reasons for a possible therapeutic strategy?

These are some of the questions that the practitioners involved bovine reproduction regularly asks their self when deciding whether to engage in this technique. The purpose of this presentation is to give a simple and honest answer to these questions.

Materials & Methods: Personal experience and a critical analysis of the bibliography on the subject of Doppler in bovine reproduction are shared. The point of view of the customer, i.e. the buyer of the service, is shared. The state of the art of the technique in practice and research is defined, and an attempt is also made to understand the possible developments of the technique also in the light of artificial intelligence.

Results: The Doppler today, for the veterinarian involved in reproductive management in the field, has its own reason for use in the indirect definition of the level of progesterone produced by the corpus luteum: this certainly opens up the possibility of more precise ultrasound reproductive management.

Doppler assessment of the corpus luteum allows an accurate diagnosis of non-gestation: 5.0-10.0% false positives and approximately 0.5-1.0% false negatives.

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The other possible applications of the Doppler technique are still at an experimental stage and have not, however, encountered definitive scientific validation.

Conclusions: It is certain that Doppler will be incorporated into all ultrasound units, even ultra-portable ones, within the next five years. With regard to its possible actual use in the field, i.e. outside scientific research, it is currently difficult to see a concrete application outside the assessment of the degree of vascularisation of the corpus luteum. The use of artificial intelligence will probably make the technique usable on a scale, reducing the objective limitations, today represented by the set up of the ultrasound unit and above all by the experience of the technician.

For those who work in the reproductive management of beef cattle and where fixed-time insemination with re-synchronisation is used, this technique finds immediate application. It is worth remembering that while around 25 million

fixed-time inseminations are carried out in Mercosur today, in other continents such as Europe, artificial insemination, and especially fixed-time insemination of beef cattle, is still an embryonic technique, also due to a whole series of limitations and prejudices related to synchronisation. In dairy cattle, on the other hand, where fixed-time insemination is widely used, there remains the problem of defining a re-synchronisation programme, currently unavailable, that allows a weekly diagnosis of non-gestation.

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Use of ultrasound to improve reproductive management in dairy or beef cattle

Giovanni Gnemmi.

BOVINEVET INTERNACIONAL Bovine Ultrasound Services & Herd Management, Huesca, Spain.

Objectives: The purpose of this presentation is to demonstrate how the use of ultrasound allows us to define in which phase (luteal-follicular) of the oestrus cycle the cow is, but also in which part of each phase (meta-oestrus, di-oestrus; pro-oestrus, oestrus). The main purpose of this evaluation is to optimise the use of oestrus synchronization of the ovulation, pre-synchronisation and re-synchronisation. But also to be able to establish, on the basis of the follicular map and the ultrasound stratigraphy of the uterus, if and when the cow could enter oestrus.

Materials & Methods: A portable or ultra-portable ultrasound scanner, working in B-Mode, allows us to define with great precision whether we are in the luteal phase or the follicular phase of the oestral cycle. In the luteal phase the hormonal profile is progestin, so the myometrium and endometrium have the same thickness and echogenicity when analysed at a frequency of 5.0-10.0 MHz. The uterine lumen, if the cow does not have a chronic inflammatory process of the uterus, will be a virtual space.

In the follicular phase, the hormonal profile is oestrogenic: the myometrium is contracted and, due to the increase in acoustic density, will be echogenic. The vascular tonaca is thickened and the endometrium is oedematous, causing dilation of the blood vessels, which will appear as small anechogenic spaces in the endometrial structure. The endometrium is hypo-ecogenic and the uterine lumen shows increased fluid, which is anecogenic. The shape of the uterine lumen is star-shaped or Christmas tree-shaped.

Once the phase of the cycle is established, we move on to define the follicular map and the presence of the corpus luteum or corpora lutei, whose age will be established on the basis of the presence of one or more dominant follicles and their size. Once it has been established in which moment of the cycle the cow is, it is possible to give indications as to whether and when she will come into oestrus, but also to establish with great precision, whether it is possible and/or convenient to resort to oestrus synchronisation (PGF2a), or synchronization of the ovulation.

Results: The more thorough the technician's knowledge of the oestral cycle and the better the quality of the ultrasound unit in use and its set-up, the greater the accuracy of the method. Possible sources of error may arise from the presence of co-dominance and/or the presence of a persistent dominant follicle from a previous oestral cycle. This assessment is based on a pre-judgment: that if we visit dairy cows, they are two-wave growth, whereas when we work with beef cows and/or heifers (both dairy and beef), they are three-wave follicular growth.

Conclusions: This technique makes it possible to define with extreme precision the estrous window in which the cow is located and whether the cow is cyclical. This makes it possible to optimise all forms of hormone therapy. However, this technique opens up a great opportunity in herds where, for various reasons, it has been decided not to resort to the systematic use of pre-synchronisation or oestrus synchronisation. It is a technique that fits in perfectly with all oestrus detection systems and allows confirmation of the indication derived from electronic or manual oestrus detection systems. It is a very precise technique, but based on a single ultrasound evaluation, it is not free of errors, which may result from the initial pre-judgment in the definition of the follicular waves and not only.

New ultrasound scanners, even ultra-portable ones, already allow automatic measurement of follicular maps. In a few years' time, with the advent of artificial intelligence, it is very likely that the accuracy of this diagnostic method will improve, making it possible to reduce the natural margin of error that exists today.

K70

Thoracic ultrasonograpy in calves: an affordable diagnostic tool in farms

Sebastien Buczinski.

Faculté of veterinary medicine, Saint-Hyacinthe, Canada.

Thoracic ultrasonography is an emerging field of research for bronchopneumonia diagnosis and management in cattle. The technique can be fastly applied in farms with the same ultrasound unit that is commonly used for reproductive purpose. Thoracic ultrasonography helps to characterize the importance of lung lesions (mainly consolidation) that are negatively associated with health and production outcomes. This ancillary tool can be useful to assess calf lung health and to monitor implementation of mitigation strategies for respiratory disease prevention and treatment. Thoracic ultrasonography is an emerging field of research for bronchopneumonia diagnosis and management in cattle. The technique can be fastly applied in farms with the same ultrasound unit that is commonly used for reproductive purpose. Detection of lung consolidation with ultrasound is reliable between different operators with minimal training. It is important to perform a bilateral examination because unilateral lung lesions are common. The right cranial lung is of special interest in calves and its specific

landmark with the internal thoracic artery and vein. Thoracic ultrasonography helps to characterize the importance of lung lesions (mainly lung consolidation) that are negatively associated with health and production outcomes. Animals with lung lesions (using various thresholds and consideration for case definition) have been found at higher risk of dyingor being culled before the first calving. Other findings associated with lung consolidation are decreased average daily gain during the preweaning period and decreased hazard of first pregnancy. Finally, decreased milk production during the first lactation has also been reported. In feedlot, beef and veal calves, thoracic ultrasonography although less studied has also been associated with various negative outcomes.

This ancillary tool can be useful to assess calf lung health and to monitor implementation of mitigation strategies for respiratory disease prevention and treatment. Thoracic ultrasonography is a fast and affordable diagnostic test that can be used calf-side with no specific investment. This is an extra-tool in the bronchopneumonia diagnostic toolbox. However, this is not a magic tool and limitations should be known when trying to implement it in practice.

Sustainable Cattle Productive Systems

K71

Sustainability in action – how do we "meat" demand without "milking" the environment

Jude Capper.

Livestock Sustainability Consultancy, Harwell, Oxfordshire, UK.

Sustainable food production is one of the most often-discussed issues within agriculture, given concerns regarding climate change, resource use, animal health and welfare, antimicrobial resistance and the provision of affordable food. Although myriad definitions of sustainable food exist, the most widely-accepted comprises a balance between economic viability, environmental responsibility and social acceptability, yet the latter component has recently become disproportionately important, as consumers have increasing questions about how their food is produced.

Livestock productivity must continue to increase in line with future population growth, so that sufficient animal source foods can be produced to fulfil consumer requirements, while lessening the impact on the environment. For example, in the USA, the move towards large-scale intensive farming conferred a reduction in the greenhouse gas emissions (GHGe) per kg of milk by 63% between 1944 and 2007, with a further 19% reduction between 2007 and 2017. Similar effects were achieved in U.S. beef systems, with an 18% reduction in GHGe per kg between 1977 and 2007; and in both pork (35% reduction between 1959 and 2009) and egg production (63% reduction between 1960 and 2010). A clear differentiation should be drawn however, between improving productivity in all livestock systems with due regard for social, economic and resource use constraints, and imposing or prescribing practices or systems with regards for sustainability impacts or trade-offs. Given the billions of smallholder and subsistence farmers across the world who rely on livestock for myriad reasons, a wholescale global transition to intensive production systems is not the solution.

Animal health is one of the key determinants of productivity, with over 20% of global animal protein lost to disease. As healthy animals produce greater yields of milk or meat, or grow at a faster rate, improving animal health reduces both the economic costs and the environmental impacts of livestock production. Animal health is also a significant consideration for many consumers, who want to be reassured that that the milk, meat and eggs that they buy come from healthy livestock. Good animal health therefore promotes social acceptability, reduces the risk of public health issues and reduces the need for veterinary medicines – a significant positive effect given the threat of antimicrobial resistance to both animal and human health. The economic benefits accruing from improved animal health, also allow improved affordability of meat, milk and eggs to the consumer.

The extent of the environmental and economic improvements conferred by improved livestock health and the quantity of data in the literature varies considerably between species and diseases. For example, the economic costs of bovine respiratory disease complex and infectious bovine rhinotracheitis