The use of ultrasonography in oestrus synchronisation programs

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Improving the reproductive efficiency of the dairy cow is an essential aspect of optimising overall herd profitability. The development of strategies aimed at improving the effectiveness of any breeding program must take into consideration the many factors which contribute to fertility in the dairy cow.

A strategy which is widely used throughout the dairy industry for the purpose of improving reproductive efficiency is the use of oestrus synchronisation programs with timed artificial insemination (TAI).

The use of transrectal ultrasonography for evaluation of the bovine reproductive tract is another strategy which is frequently employed on dairy farms.

The specific type of synchronisation program utilised may vary considerably between farms depending on the management system of the herd, herd size, personal preference of the veterinarian and farmer, economic considerations and many other factors.

However, regardless of the type of synchronisation program utilised, there are potential benefits to combining the use of ultrasonography with these programs.

The primary benefit is a better response of the cow to synchronisation and therefore an improvement in reproductive performance.

For the purposes of this article, the focus will be on lactating dairy cows, although it is important to remember that synchronisation programs may also be beneficial to the management of heifers within the herd.

Bovine reproductive cycle

Effective manipulation of oestrus through hormonal control using a synchronisation program must be based on a fundamental understanding of the normal sequence of events which takes place during the 21-day bovine oestrus cycle.

The two phases of the oestrous cycle are the follicular phase and the luteal phase. During the follicular phase, the primary structures present on the ovary are preovulatory follicles which produce oestrogen.

Oestrogen stimulates the release of gonadotropin releasing hormone (GnRH) which is essential for induction of ovulation of the dominant follicle.

The elevated levels of oestrogen throughout the follicular phase are also responsible for the cow displaying signs of oestrus or 'heat'.

The end of the follicular phase is marked by ovulation occurring.

The luteal phase is characterised by the presence of a corpus luteum on the ovary. The corpus luteum develops from what remains of the dominant follicle which ovulated at the end of the preceding follicular phase and is a source of progesterone.

The role of progesterone in the oestrus cycle is to prevent further development of a dominant, ovulatory follicle by inhibiting GnRH release. Furthermore, the presence of high levels of progesterone throughout the luteal phase prevents the cow from displaying signs of behavioural oestrus or 'heat'.

Progesterone also plays an essential role in the maintenance of pregnancy. If the cow does not become pregnant, prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$) is released from the wall of the uterus which results in regression (lysis) of the corpus luteum.

Lysis of the corpus luteum in response to $PGF_{2\alpha}$ results in a dra-

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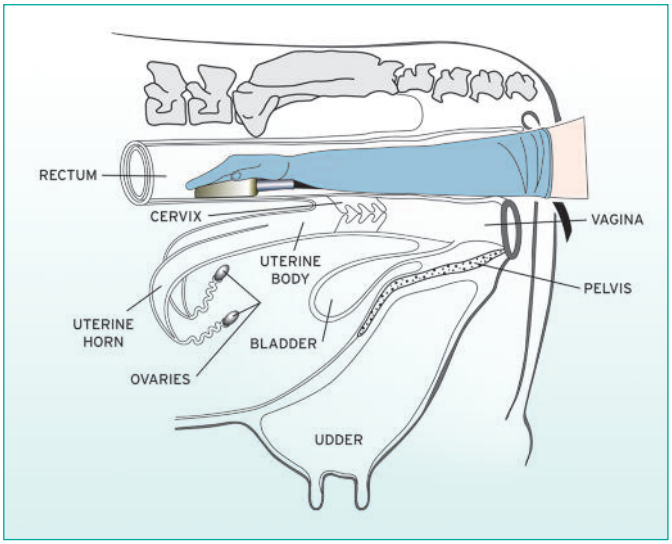
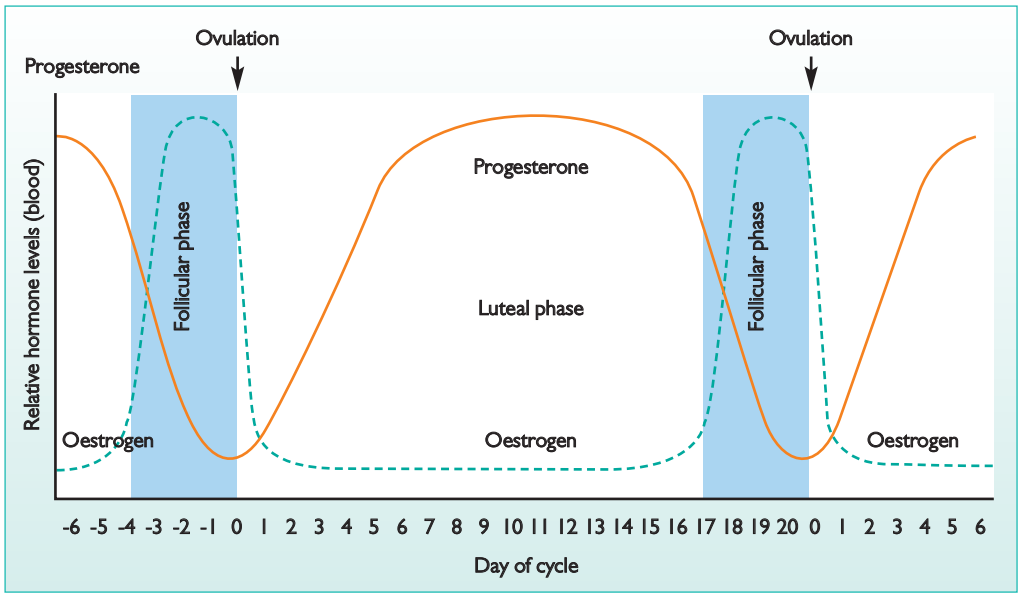


Fig. 2. Illustration of transrectal ultrasonography being used to evaluate the reproductive tract of the dairy cow.

Fig. 1. Diagram of the bovine oestrus cycle illustrating the relative levels of oestrogen and progesterone during the follicular and luteal phases of the cycle.



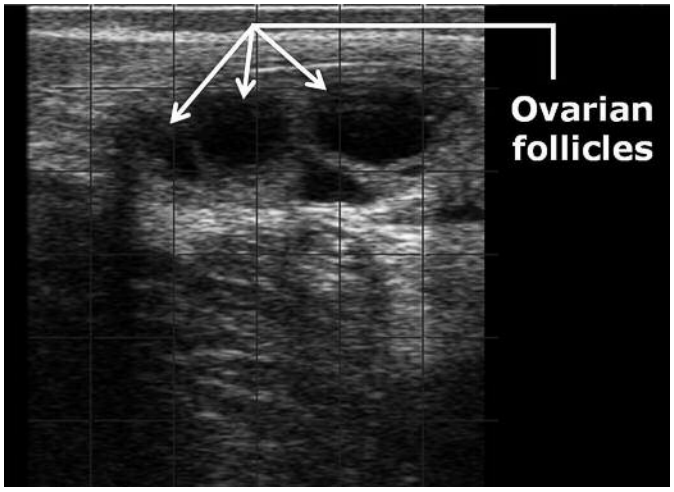


Fig. 3. Ultrasound image of the bovine ovary with several follicles, which appear as circular, anechoic (black) structures (arrows). Images obtained using BCF Easi-Scan.

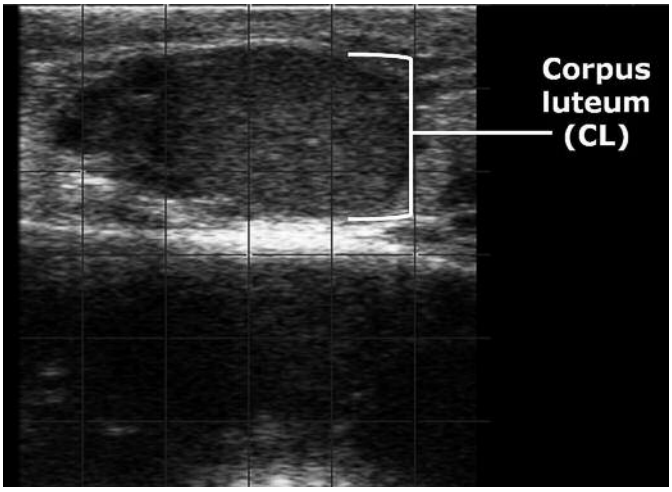


Fig. 4. Ultrasound image of a corpus luteum (CL) on the bovine ovary, which appears as a grey, circular structure (arrow). Images obtained using BCF Easi-Scan.

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matic fall in progesterone production and a return to the follicular phase of the cycle (Fig. 1).

Oestrus synchronisation

The roles of oestrus synchronisation programs in dairy herd management strategies include:

- Control of follicular growth in heifers and post-partum cows in preparation for first TAI service.
- Resynchronisation of cows which fail to conceive after TAI.
- Treatment of cows which have cystic ovarian disease or are anoestrus.

Synchronisation programs are based on mimicking the normal physiological action of various hormones on the bovine reproductive tract through the use of naturally occurring or synthetic analogues of these hormones.

The timing of administration of synchronisation treatments depends on various factors including specific program selection and whether a whole herd or individual cow approach is taken.

Regardless of the choice of synchronisation program, the most commonly used drugs mimic the effects of GnRH, progesterone or $PGF_{2\alpha}$.

Use of ultrasound

The general benefits of the use of transrectal ultrasonography as a bovine reproductive management tool have been previously described (Fig. 2). These include:

- Earlier, more accurate determination of pregnancy status compared to manual palpation.
- Assessment of foetal viability through visualisation of a heartbeat.
- Identification of twin foetuses.
- Determination of foetal gender.
- Identification of uterine and ovarian structures. However, there are also several additional advantages of using ultrasonography in combination with oestrus synchronisation and TAI programs.

One advantage is the ability to determine if a cow has returned to cyclicity following calving. In the post-partum period, signs of a cow returning to normal cycling activity may not always be apparent based on heat detection alone. The use of ultrasonography enables the ovaries to be examined for the presence of structures such as preovulatory follicles (Fig. 3) or an active corpus luteum (Fig. 4) which would indicate that the cow has resumed normal cycling activity.

Additionally, this information may be used to classify the cow as being in either the follicular or luteal phase of the cycle, enabling the synchronisation program to be initiated appropriately.

Ultrasonography may be used at various stages throughout the synchronisation program and this should be tailored to complement the overall management strategy of the individual dairy herd (Fig. 5).

Economic benefits

The efficacy of a synchronisation and TAI program may be gauged in various ways, however a general indicator of success is an improvement in the calving to conception interval. This is due to the fact that the optimum interval between successive calvings for the individual cow (referred to as the calving interval) of 365 days relies on the cow becoming pregnant (conceiving) within 85 days of calving (the optimum calving to conception interval).

The reported cost of an extended calving interval, which may be expressed in terms of 'days open', has been stated as reaching up to $3 per cow per day. In the UK, Hudson reported that this cost is estimated at approximately £4 per cow per day for cows which exceed the optimum calving interval by 30-60 days.

Therefore, in order to limit this negative economic impact, it is essential that the calving to conception interval be minimised.

The use of ultrasonography in synchronisation/TAI programs may be beneficial in achieving a reduced calving to conception interval by enabling:

- The synchronisation program to be initiated at the correct stage of the oestrus cycle.
- Cows which do not appear to have resumed cycling post-partum to more accurately be classified as truly anoestrus, compared to relying solely on heat detection, manual palpation of the ovaries for the presence of a functional corpus luteum or a single measurement of blood progesterone (P4) concentration. Therefore, anovulatory anoestrus cows may be identified and treated appropriately.
- Earlier detection of pregnancy compared to manual palpation, therefore non-pregnant cows may be resynchronised and rebred more quickly.
- Pathology within the reproductive tract which may negatively affect fertility to be readily identified prior to the induction of the synchronisation program.

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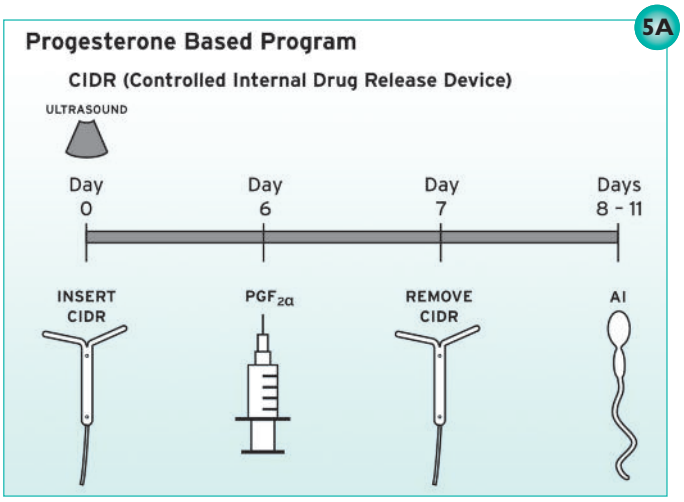
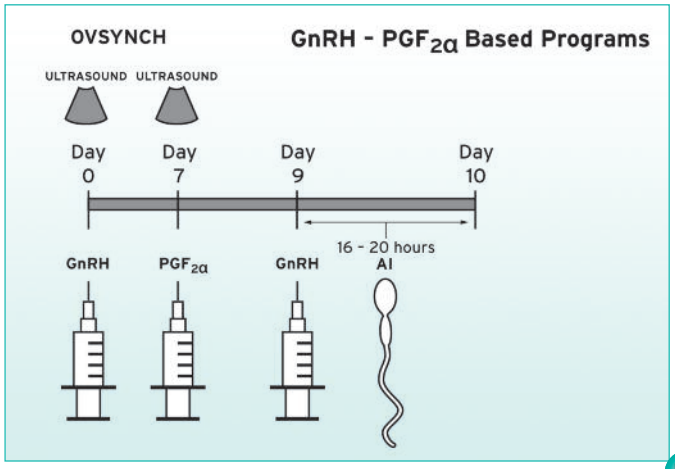
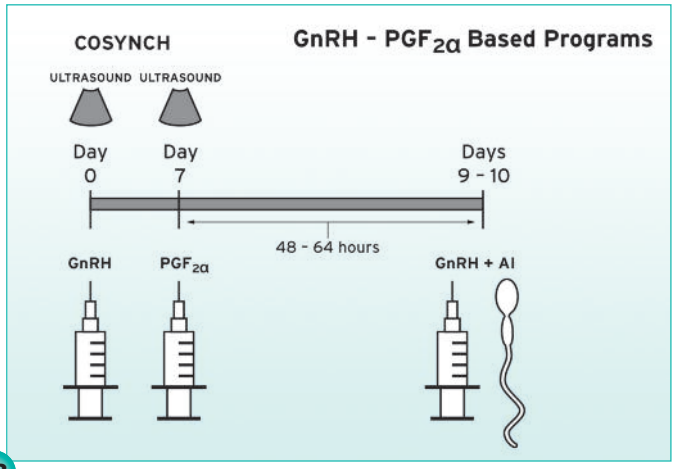
Fig. 5. Comparison (A, B and C) of various oestrus synchronisation programs commonly used in reproductive management of dairy herds and where ultrasound may be incorporated into these protocols. A. Illustration of a commonly used progesterone based synchronisation program. Progesterone is continuously released from a CIDR device, inserted into the vagina, which suppresses follicular development and display of oestrus behaviour. This program has also been used to initiate oestrus activity in anoestrus cows. The $PGF_{2\alpha}$ injection will cause regression of a CL (if present) and once the CIDR is removed, development of a dominant follicle will resume and ovulation will occur, after which AI may be performed. When determining if a progesterone based synchronisation program is a suitable protocol choice, ultrasonography can provide additional useful information such as the reproductive status of the cow and presence of ovarian/uterine pathology.







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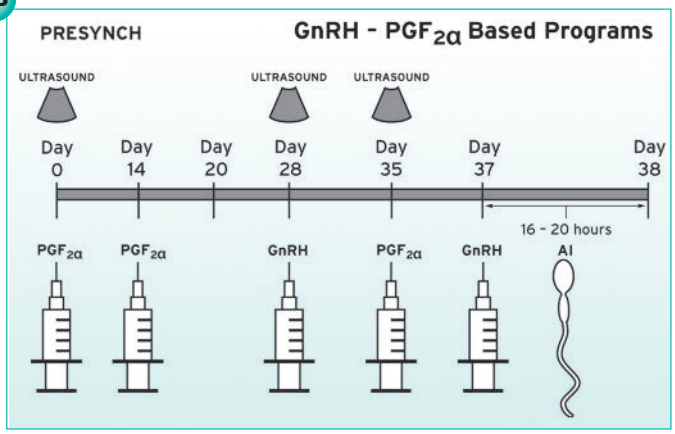
B. Comparison of various GnRH-PGF2α based synchronisation programs. The first GnRH injection is used to promote ovulation of an existing dominant follicle with formation of a CL and it will also induce new follicles to develop, allowing a CL and a new dominant follicle to be present at the time of the PGF2α injection seven days later. Ultrasound may therefore be used to determine if the cow is cycling and what stage of the cycle she is in prior to the administration of the first GnRH injection. Ultrasound may also be helpful in determining if an active CL is present on the ovary as this is when PGF2α will be most effective. If a CL is not observed at this stage, the synchronisation program may be modified appropriately.



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For example, studies of endometritis in post-partum dairy cows indicate that cows with endometritis generally have a longer calving to conception interval with median values ranging from a 140-206 days open compared to 118-121 days open for cows without endometritis.

Transrectal ultrasonography may be used to identify these cows prior to first service so that the condition may be resolved through appropriate, targeted treatment.

Therefore, introduction of ultrasonography into the oestrus synchronisation program may allow cows to be bred more efficiently and effectively, resulting in a decreased calving to conception interval and an overall economic benefit to the farm. ■

References are available from the author on request

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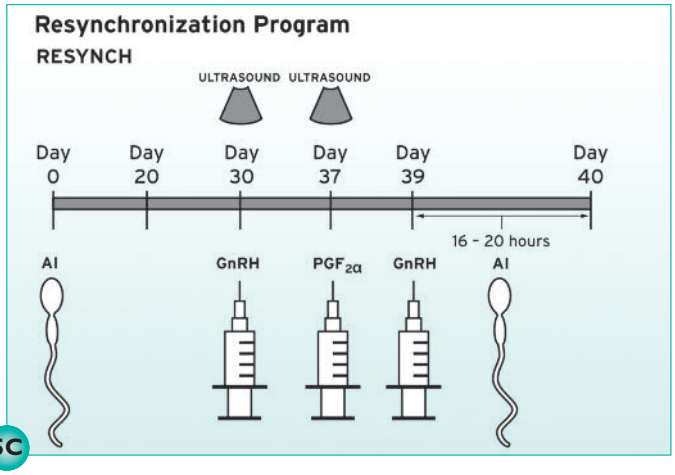

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C. Illustration of a commonly used resynchronisation program. This is similar to the previously described GnRH- PGF2α based programs, however it is started after a cow has been determined to be non-pregnant following AI. Ultrasound may be used for pregnancy diagnosis around day 30 post AI, enabling a resynchronisation program to be initiated rapidly with an injection of GnRH once a cow has been classified as non-pregnant. Another ultrasound examination performed seven days later will enable the operator to determine if a CL is present which would be responsive to PGF2α, as previously described in (B).