Role of Early Pregnancy Diagnosis by Means of Ultrasonography in Improving Reproductive Efficiency in a Dairy Herd: A Retrospective Study

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Abstract

Transrectal ultrasonography (7.5 MHz linear-array transducer) was used in a Hungarian Holstein-Friesian dairy herd to evaluate the accuracy of finding a corpus luteum on day 20 or 21 or a conceptus on day 29 or 30 after service, respectively. All of the cows with non-pregnancy diagnoses and having a corpus luteum were reexamined on day 33 or 34 after AI. The final ultrasonographic examination was made between days 53 to 58 after service. Some non-pregnant cows (n=20) could already be recognized by the absence of a corpus luteum at the first ultrasonographic examination on day 20 or 21 after AI and these cows might be treated at this early stage if needed. The false negative ultrasound diagnoses (n=7) made on day 29 or 30 after AI could be corrected on the basis of repeated ultrasonographic examinations 3 to 4 days later. With the exception of one cow, every non-pregnant cow was correctly diagnosed on day 29 or 30 after AI and these cows might be treated at this stage if needed. Three to four ultrasound examinations might contribute beneficially to the achievement of optimal calving to conception interval in field conditions.

Introduction

The achievement of an optimum calving to conception interval of 85 to 115 days requires concentrated management activities during the first 90 days following calving. Accurate and early detection of pregnant and non-pregnant cows may be a key factor in achievement of optimal calving to conception interval.

One of the most recent techniques for early pregnancy diagnoses in cattle on the farm is B-mode ultrasonography (US). The reliability of the test greatly depends on the frequency of the transducer used. The accuracy of a 5 MHz transducer for the detection of the conceptus from 20 days after AI onwards has been investigated by several authors, but under field conditions acceptable results could only be achieved from 26 to 27 days after service (1,2,3). However, Badtram et al (4) reported an accuracy of 69 % and 72 % for pregnant and non-pregnant cows, respectively, using ultrasonography between 23 and 31 days after insemination. In these cases the confirmation of ultrasonic diagnoses was based on palpation per rectum of the uterus at 2 to 3 months after AI or on spontaneous return to estrous after AI. Under controlled experimental conditions, the accuracy of a 7.5 MHz linear-array transducer for early pregnancy diagnosis was 100 % by day 20 (5,6). However, similar results could not be reached in field studies (7,8).

The present study was undertaken to investigate to what extent the accuracy of transrectal ultrasonography can be improved by ultrasonic scanning of the ovaries on day 20 or 21 and by repeated ultrasonic scanning of the uterus in field conditions from day 29 or 30 after service onwards.

Materials and methods

Ultrasonographic examination of the ovaries were performed in 165 Holstein-Frisian dairy cows (entering their first to eighth lactation) on day 20 or 21 after AI with a real-time, B-mode diagnostic ultrasound scanner (Type 450, Pie Data Medical, Maastricht, The Netherlands) equipped with a 7.5 MHz linear-array rectal transducer. Examination was done in stalls in the milking house with dim ambient lighting. Ovaries were examined for the presence of a corpus luteum which appeared as a round or oval image of variable echogenesity. Follicles were frequently encountered as non-echogenic, round structures. On day 29 or 30 after AI the entire uterus was imaged. No manipulation of the uterus took place in any of the investigations. Scanning of the uterus and interpretation of the echoscopic images have been described previously (7). At each examination, the operator was required to record a diagnosis of either preg-

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nant or non-pregnant. The recognition of allantoic fluid was used as an obligatory criterion for a positive pregnancy diagnosis. All of the non-pregnant cows were reexamined on day 33 or 34. An animal was designated as pregnant if an embryo proper with a beating heart was recognized at a final ultrasonic examination between days 53 and 58 after AI. In addition, palpation per rectum of the uterus took place between days 75 and 90 after AI to confirm whether the cows were pregnant. The pregnancy diagnoses were also confirmed by calving records or by another observed event such as abortion. Cows diagnosed as non-pregnant between days 53 and 58 were designated as non-pregnant. Late embryonic mortality was defined as a condition when an embryo was present, but without a heart beat, or when a positive ultrasonographic test was followed by a negative test. These diagnoses were designated in the results as correct positive ultrasound diagnoses.

The results of ultrasonography were arranged as follows: correct positive diagnosis (a); incorrect positive diagnosis (b); correct negative diagnosis (c) and incorrect negative diagnosis (d). From these values the sensitivity (100xa/a+d), the specificity (100xc/c+b), the positive predictive value (100xa/a+b) and the negative predictive value (100xc/c+d) of the pregnancy test were calculated.

Results

On day 20 or 21 after AI, the ovaries of 165 dairy cows were examined by means of ultrasonography and 144 cows had a corpus luteum. No corpus luteum was present in the remaining 21 cows. These cows had several follicles with different sizes (Table 1). Among these cows, 6 were reinseminated until the next ultrasonographic examinations on day 29 or 30 after service.

Table 1. Cows with follicles on Day 20 or 21 after AI.

Diagnosis	Day 29 or 30 (n)	Days 53 to 58 (n)
Reinsemination	6	11
Follicles	5	
Corpus luteum (CL)	8	
CL and pregnant	1	
Purulent discharge	1	
Non-pregnant		7
Culling		2
Totals	21	20

Henceforward, follicles were found in 5 cows while a corpus luteum was diagnosed in 9 cows, but with the exception of one cow they were not pregnant. One cow had a purulent discharge. Cows with a corpus luteum (n=8) were reexamined on day 33 or 34 and non-pregnancy diagnoses were confirmed. Until day 53 to 59 when the last ultrasonography was performed an additional 5 cows were reinseminated. Seven cows were not inseminated again and were non-pregnant. Two cows were culled because of reproductive failure.

A corpus luteum was found by ultrasonography in 144 cows on day 20 or 21 after service (Table 2). Among these cows, 35 were reinseminated until day 29 or 30 after service: therefore the reproductive organs of 109 dairy cows were examined on day 29 or 30 after service. Fifty-five of 109 cows were declared as pregnant by ultrasonography between days 53 to 58 and by rectal palpation of the uterus between days 75 to 90 after AI, respectively. With the exception of one cow (Table 1), in all calving cows, including cows with late embryonic mortality (n=65), a corpus luteum was found by ultrasonography on day 20 or 21 after AI. On day 29 or 30 after service, with the exception of 7 false negative diagnoses, all calving cows (n=55) and cows with late embryonic mortality (n=10) were correctly diagnosed. With the exception of one cow, all non-calving cows were diagnosed correctly.

Table 2. Cows with a corpus luteum on day 20 or 21.

Diagnosis	Day 29 or 30 (n)	Days 33 or 34 (n)	Days 53 to 58 (n)
Reinsemination[a]	35		12
Pregnancy diagnosis correct	58	7	65[b]
Pregnancy diagnosis incorrect	1		
Non-pregnancy diagnosis correct	43	23[c]	31 (+1)
Non-pregnancy diagnosis correct	7		
Sensitivity	89.2	100	100
Specificity	97.7	100	100
+ predictive value	98.3	100	100
- predictive value	86.0	100	100

[a]Cows were reinseminated until day 29 or 30 and until days 53 to 58, respectively
[b]Late embryonic mortality occurred in 10 cows
[c]Only those cows were reexamined which had a corpus luteum on day 29 or 30

The specificity of ultrasonography was 97.7 % on day 29 or 30 after AI. Twenty of 43 cows with non-pregnancy diagnoses had follicles on their ovaries, therefore

only those cows with a corpus luteum (n = 30) with non-pregnancy diagnoses were reexamined 3 or 4 days later. With repeated ultrasonography, the 7 false negative diagnoses were confirmed because these cows were actually pregnant. There was one cow with a false positive ultrasound diagnoses which was confirmed only between days 53 to 58 when the following ultrasonographic examinations were done.

Discussion

The achievement of an optimal calving to conception interval (less than 100 days) requires concentrated management activities after calving. Early postpartum breeding of dairy cows results in more calves, and higher milk production per lactation. Accurate and early detection of pregnancy therefore plays a key role in achievement of optimal calving to conception interval. The bovine uterus is coiled and tortuous, and in 73 % of the cases, the shape of the apparent embryonic vesicle in the early stage of pregnancy (10-20 days) is round, while in the remainder (27 %) it is oblong (9). Thus, particularly under field conditions, acceptable ultrasonographic results (5 to 7.5 MHz transducer) could not be achieved before days 26 to 27 after AI (1-4,7,8). In the present study, therefore, only the ovaries were examined by ultrasonography on day 20 or 21 in order to select cows with a corpus luteum. With the exception of one cow, a corpus luteum was found in all pregnant cows on day 20 or 21 after AI. In agreement with previous findings, a corpus luteum can be diagnosed with high accuracy if a 7.5 MHz transducer is used (10). There were 21 cows which had no corpus luteum. With the exception of one cow, every non-pregnant cow was correctly diagnosed on day 20 or 21 because they were confirmed not pregnant on day 29 or 30 after AI. Similarly the absence of a corpus luteum can be diagnosed with high accuracy if a 7.5 MHz transducer is used (10).

Transrectal pregnancy diagnosis with a 7.5 MHz transducer on day 29 or 30 after AI resulted in 7 false negative diagnoses in the 65 animals which delivered a calf (n=55) or had late embryonic mortality (n=10). Every cow with a non-pregnancy diagnosis and with a corpus luteum was reexamined on day 33 or 34 after AI. This way all of the pregnant cows were correctly diagnosed by day 33 or 34 after AI. With the exception of one cow, all of the non-pregnant cows were correctly diagnosed by ultrasonography on day 29 or 30 after AI. The remaining cow which was declared as non-pregnant at the last ultrasound examination between days 53 to 58 was designated in the results on day 29 or 30 as a false positive diagnosis. This cow might have resulted from a false interpretation of the ultrasound image or from a wrong documentation.

Conclusions

Some non-pregnant cows (n=20) could already be recognized by the absence of a corpus luteum at the first ultrasonographic examination on day 20 or 21 after AI, and these cows might be treated at this early stage if needed. The false negative ultrasound diagnoses (n=7) made on day 29 or 30 after AI could be corrected on the basis of repeated US examinations 3 to 4 days later. With the exception of one cow every non-pregnant cow was correctly diagnosed by day 29 or 30 after AI, and these cows might be treated at this stage if needed. If pregnancy diagnosis is scheduled on the farm later than 40 days after AI, our results show that 38 non-pregnant cows could not have been discovered until that period. Three to four ultrasonographic examinations might contribute beneficially to the achievement of an optimal calving to conception interval in field conditions.

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