

NEW SITES FOR THE USE OF PULSE-MODE ULTRASOUND TO DETECT PREGNANCY IN CATTLE

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(1983 Unpublished)**

SUMMARY

New sites developed for improved cattle testing are described in this paper. Two separate trials were conducted on a total of 379 Friesian and Brahman cows. In the first test, conducted with an early version of the *RENCO PREG-ALERT*^{®(2)} modified for cattle testing, the accuracy rate was 96.6% for non pregnant cows, and 90.4% for cows determined to be 5 weeks to 8 months pregnant by rectal palpation. An overall accuracy of 94.8% (both pregnant and non pregnant) was achieved with one test and 95.5% after necessary second retests.

The second test, using the latest version of the same instrument, produced an accuracy of 88.9% in a total of 27 cows after one test. A second test on the uncertain animals resulted in an accuracy of 96.3%. (Only one cow out of 27 was wrongly diagnosed after two tests.)

To ascertain the ease of learning the techniques, both skilled and unskilled operators were used.

INTRODUCTION

Ultrasound has been used for pregnancy testing of animals and humans over the past two decades. Initially, Doppler ultrasound instruments were used, but they did not find widespread acceptance since they required extensive training for operators and freedom from distracting noise during use. Testing time was rather prolonged because the probe had to be accurately positioned to pick up the fetal heart beat (Biedermann, 1980). Frazer et al (1971) and Weiss (1975) report on the use of the Doppler instrument on 56 and 24 cows respectively. According to Frazer et al, pregnancy detection was possible only after 4 1/2 months.

More recently, the pulse mode instrument, which initially was used to measure backfat in swine, was adapted for use as a pregnancy tester for swine and sheep. This system permitted fast (30 second) testing by inexperienced workers. Ultrasound, emitted from a probe coupled to the body by a thin film of oil, will produce an echo when it hits upon a tissue/fluid interface. This interface occurs in the pregnant uterus between the amniotic fluid and the uterine wall and between amniotic fluid and fetus. The echo is picked up by the same probe (now working as a microphone) and translated into electrical signals. These signals, appearing as "spikes", are displayed on an oscilloscope screen. If the echo originates from a depth within the body corresponding to the depth where the uterus is usually found, a tone is sounded, as an additional indication to the operator. Depth markers also appear on the screen to enable the operator to gauge the depth of the echo accurately.

To this time, little work trying to detect pregnancy in cattle using this type of device has been reported in the literature. Hansen (1979, unpublished) reported a test on 8 Jersey cows that were pregnant from 30 to 90 days. He could detect only 4 pregnancies by applying the probe only on the side of the animal ("hunger groove"). Biedermann (1980), using a PREG-ALERT, found the site described by Hansen to be ineffective. The site was 0 to 7.5 cm rostral and 12 to 15 cm ventral to the Tuber sacrale, with the probe pointed to the left leg. Biedermann obtained good results fairly late in pregnancy (over 4 months)

from a few sites around the udder; (a) rostral and lateral to the udder, (b) between the kneefold and udder, and (c) between the shank and udder on the cow's right side. For 343 tests in this region, he achieved an accuracy of 88%. Accuracy was 84% in known pregnant animals and 93.5% in non pregnant animals. For animals pregnant 4 months or more, his accuracy became 100%, but a 6.5% false positive rate occurred in non pregnant animals. He notes a false positive could result from a full bladder, particularly in early pregnancy (when uterus and bladder lie close together). Following Biederman's work, other sites, promising from anatomical considerations, were investigated by the authors.

ALTERNATIVE SITES FOR PREGNANCY TESTING OF COWS

During early pregnancy, to about 8 weeks, the uterus lies within the pelvic cavity. The only way to interrogate the uterus with the ultrasound beam seemed to be through the gluteus muscle and the greater sciatic foramen. This site proved to be very suitable for early pregnancy detection. Positive signals were obtained from 28 days to about 11 weeks after conception. To locate the best testing zone, visualize an imaginary line from the Tuber ischii to the Tuber sacrale. The midpoint on this line, used as a marker, is referred to as the "Sacroiliac point", (S-I). The area surrounding this point, as shown in Figure R, on both the left and right sides is designated the S-I area. False positive signals (possibly for the partially filled bladder or cervical mucus) were sometimes observed when the probe was positioned caudal to the S-I point.

MATERIALS AND METHODS

Three hundred fifty two Friesian-Holstein cows were tested at varying stages of pregnancy. Pregnancy or service records were not known to the examiners. Animals were packed tightly in a chute with their heads facing left. One of the authors (GPR), for the first trial, examined each cow at 4 different sites with the earlier model, (PREG-ALERT Type 2). In sequence these areas were as follows:

- (a) Right S-I area. (See Figure R, PREG-ALERT OPERATOR'S MANUAL.)
- (b) Left S-I area.
- (c) Early Groin area, (EG) -- Probe was placed high up into right groin between abdomen and right femur, probe pointing rostral to region bounded by a line drawn between the two Tuber sacrale caudally, left Tuber sacrale, right Tuber sacrale, and the last ribs rostrally. (See Figure U, PREG-ALERT OPERATOR'S MANUAL.)
- (d) Late Groin area, (LG) -- Probe placed immediately adjacent and lateral to the right side of the udder. It was directed towards area bounded by line between Tuber sacrale caudally, left stifle joint ventrally and the head and neck region rostrally. (See Figure W, PREG-ALERT OPERATOR'S MANUAL.)

As in the case of the S-I areas, care was taken in the EG and LG areas not to direct the probe caudal to the Tuber Sacrale.

Each area was painted liberally with vegetable oil, and the probe placed perpendicular to the oil saturated skin. Several tall "skin contact" spike signals appeared on the far left of the PREG-ALERT screen immediately upon good contact between skin and probe. (Sound is not

entering the body if these "skin contact" signals do not appear, a condition which is usually due to insufficient use of coupling oil between probe and skin.) While keeping the probe on the same spot, the probe was "rocked" in a circular motion in order that the pencil shaped beam would search in all directions. When a small spike signal appeared in the third segment, or beyond, of the tester screen, the probe was immediately held facing the direction from which the echo originated. Generally the spike signal would become larger, and the tone sounded, with slight optimizing of the probe direction. The operator would soon develop skill in optimizing the search strategy. It is akin to searching a darkened room for a small object with a flashlight. The test was regarded positive if a single or multiple spike(s) appeared in the third segment or beyond whether a tone signal was heard or not. The spike indicated a fluid filled cavity at the appropriate distance from the probe.

The cow tested was examined immediately by rectal palpation by another author (ECG) and the results compared. If disagreement, a second test was performed. If a full bladder was palpated, a concerted effort was made to obtain a signal (false) from it.

After the first trial using the new test sites, it was suggested to the manufacturer that the range and search depth of the instrument be changed, to simplify the testing procedure. Then a second, more limited, test was made to verify the usefulness of these modifications. For the second trial, an additional procedure to determine the stage of pregnancy was tested, in addition to the procedure of trial one. Table 1 relates the stages of pregnancy to the areas producing positive indications.

TABLE 1:
DETERMINATION OF PREGNANCY STAGE WITH THE RENCO PREG-ALERT

STAGE OF PREGNANCY:	TESTS SITES FROM WHICH POSITIVE "PREGNANT" SPIKE SIGNALS COULD BE OBTAINED ON THE SCREEN, AT THE STAGES NOTED AT LEFT:
4 Weeks -- 10 Weeks	SI Area Only
11 Weeks -- 14 Weeks	SI & EG Areas
15 Weeks -- 18 Weeks	EG Area Only
5 1/2 Months -- 7 Months	LG Area, & Sometimes EG Area
Over 7 months	Positive Spikes from All Areas

Twenty seven Brahman cows were used for this trial and were examined rectally by the authors to ascertain pregnancy. To observe the difficulty in learning the procedure, an independent farmer and his farm manager were taught the procedure and used as testers. Neither had ever seen the instrument before the trial. When an incorrect diagnosis was made by the trainees, one of the authors did a second test to check if poor technique was the cause. To avoid possible influence of the outcome caused by displacement of the organs during rectal examination, half of the rectal palpations were done before the trainees tested the cows with the PREG-ALERT, and half done afterwards. When the rectal examination preceded the ultrasound test, an attempt was made to replace the organs in exactly the same position if displaced. Rectal exam results were not disclosed to the trainees until all tests were concluded.

RESULTS

TRIAL 1:

Of the 206 cows tested negative (sample population of 352) by rectal examination, all but 7 were correctly diagnosed (96.6%). Of the 7 not correctly diagnosed, the following remarks were noted:

- 4 cows "Suspicious, test again later."
- 1 cow "Possibly 4 weeks pregnant."
- 1 cow "False positive at LG position."
- 1 cow "False positive at S-I, possibly due to pyometra."

Of the 146 cows pregnant by rectal examination from 5 weeks to 8 months, a total of 132 (90.4%) were diagnosed correctly at the first test. An additional 6 cows were diagnosed correctly at the second attempt, giving an overall accuracy of 95.5%. These results are detailed in Table 2.

During this test it was observed that results around 12 weeks were rather poor. At this stage of pregnancy, the uterus is almost entirely over the pelvic rim into the abdominal cavity, but does not lie low enough for the ultrasound beam to reach it from the EG test site. If this period is not considered in the calculations, the accuracy was 96% (123 out of 128) at the first attempt.

It was noted that in a few cows, it was possible to obtain a false positive from a partially extended bladder by placing the probe caudal to the S-I point. It was not possible to obtain a false positive from any of the cows with extended bladders from any of the test sites.

TRIAL 2:

Of the 27 cows tested, 26 were pregnant and 24 were correctly diagnosed by the newer PREG-ALERT. Two of the three cows wrongly diagnosed were 6 weeks pregnant and correctly diagnosed at a retest. The mistake made by the trainee operators in both cases was that the probe was not directed towards the midline. The uterus was situated directly beneath the spinal column. The only cow with a false negative test which remained negative after a retest was approximately 12 weeks pregnant. Detailed results are shown in Table 3.

DISCUSSION

These results show an accuracy rate far above any previously described in the literature. It is also the first time that the stage of pregnancy could be assessed by ultrasound. The second trial showed that these instruments and techniques are easy to master, as unskilled laymen master the technique within 30 minutes. Both trials confirm that the instruments become unreliable at detecting pregnancy at around 12 weeks, and that a certain amount of skill is necessary at the early stages of pregnancy. To circumvent the lack of sensitivity at 12 weeks, a practical way of getting accurate results would be to retest all negative cows 3 weeks after the first test. Any cows that were at the 12 week stage or less than 4 weeks during the first

test would, at the second testing, be at a stage where accuracy is very high. False positives may result from cases of pyometra or mucus during estrus. This will constitute a very small percentage in normal herds.

CONCLUSION

The instruments tested are accurate tools to diagnose pregnancy from 4 weeks in cows by operators with a modicum of training. It can obviously never replace rectal palpation by a skilled veterinarian, especially since it is possible for a veterinarian to diagnose reproductive disorders during a routine rectal examination. But for ranchers far away from veterinarians or as a way of screening a herd prior to a veterinarians visit, the PREG-ALERT could be an extremely useful tool. Only cows testing negative with the instrument need then be examined by the veterinarian, to pick out the false negatives at 12 weeks, and to examine the non pregnant cows for reproductive problems.

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TABLE II:**COMPARISON BETWEEN PREGNANCY DIAGNOSIS BY RECTAL PALPATION AND THE RENCO PREG-ALERT TYPE 2**

STAGE OF PREGNANCY	NO. COWS PALPATED	RENCO PREG-ALERT		
		NO. COWS CORRECTLY DIAGNOSED	NO. COWS INCORRECTLY DIAGNOSED	NO. COWS CORRECTLY DIAGNOSED AFTER 2 TESTS
Not Pregnant	206	199 96.6%	7 3.4%	199 96.6%
5 - 9 Weeks	8	5 62.5%	3 37.5%	8 100.0%
10 - 14 Weeks	18	8 44.4%	10 55.6%	9 50.0%
4 - 8 Months	120	118 98.3%	2 1.7%	120 100.0%
TOTALS:	352	330 94.8%	22 6.3%	336 95.5%

TABLE III:**A COMPARISON BETWEEN PREGNANCY DIAGNOSIS BY RECTAL PALPATION AND THE RENCO PREG-ALERT TYPE 2B**

STAGE OF PREGNANCY	NO. COWS PALPATED	RENCO PREG - ALERT							
		NO. COWS CORRECTLY DIAGNOSED		NO. COWS CORRECTLY DIAGNOSED AFTER TWO TESTS		NO. COWS CORRECTLY DIAGNOSED FOR STAGE OF PREG.		NO. COWS INCORRECTLY DIAGNOSED AFTER ONE TEST	
Not Pregnant	1	1	100.00%	1	100.00%	1	100.00%	0	0.0%
6 - 10 WEEKS	6	4	66.7%	6	100.00%	4	100.00%	2	33.3%
11 - 14 WEEKS	8	7	87.5%	7	87.5%	7	100.00%	1	12.5%
15 WEEKS - 4.5 MC	2	2	100.00%	2	100.00%	2	100.00%	0	0.0%
5 - 7 MONTHS	9	9	100.00%	9	100.00%	9	100.00%	0	0.0%
8 MONTHS	1	1	100.00%	1	100.00%	1	100.00%	0	0.0%