

Rectal palpation for pregnancy in cows: A relic or an alternative to modern diagnostic methods

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Summary

Early diagnosis of pregnancy in cattle is an important factor determining the profitability of breeding. It can shorten the intercalving period by accelerating the next insemination procedure or diagnosing the cause of infertility. Palpation of the reproductive system per rectum is a method used for more than 100 years. It involves palpation of the uterine horns to detect the fetal vesicle, fetus water and the embryo itself. The earliest time when the fetal bladder can be detected is the 28th day after insemination in heifers or the 32nd-35th day in multiparous cows. The method is fast and cheap, it does not require additional equipment, and the result is immediate. An effective examination by this method is not easy and requires theoretical and practical preparation. The method also involves the risk of causing fetal damage, resulting in the loss of pregnancy and deterioration in the cow's well-being. An upgrade of the method is the introduction of ultrasound rectal examination, which increases the efficiency of diagnosis and shortens the time from insemination to examination. Despite its long history, the diagnosis of early pregnancy by rectal examination has not lost its importance or popularity. Although new methods of diagnosing pregnancy continue to be introduced in today's practice, they do not diminish the importance of rectal palpitation.

Keywords: pregnancy diagnosis per rectum, advantages and disadvantages, pregnancy losses, welfare, cows

The palpation of the reproductive system through the rectal wall (palpability of the rectum) has been routinely used in the diagnosis of pregnancy in cows since the beginning of the last century (10, 30). Up till now, it has been one of the basic methods in the reproduction management of cows (7). Each additional day of the period between transrectal examination performed after day 30 after insemination resulted in a 1.09 day increase in the interparturition period (48). Despite the emergence of new diagnostic methods, such as ultrasound and indirect pregnancy tests, the popularity of the method and the large confidence in it remain high (7, 12, 14, 17, 34, 36, 38, 40).

Advantages and disadvantages of the recto-manual (transrectal) method of pregnancy diagnosis

A number of important arguments support the transrectal palpation (TRP) method: it is a precise pregnancy diagnostic method, relatively cheap and requiring no special equipment (7, 9, 32). The latest cal-

culations show that it is still an alternative for the PAG chemical test, whose unit price in large cattle herds is estimated at \$ 2.4-3.75, in smaller ones at \$4 (29, 32, <http://newsroom.unl.edu/announce/beef/6982/40017>). Moreover, it is less labor intensive as compared to other methods. The test – with high accuracy – can be carried out in cows between 30-35 and 90 days after mating or covering, but usually rectal examinations take place between 45 and 60 days after insemination or covering (8, 30). It is a fast method (up to 100 head can be checked in an hour by a skilled veterinarian) (<https://www.albertafarmexpress.ca/2015/07/30/checking-cattle-for-pregnancy-rectal-palpation-versus-ultrasound/>). In addition, rectal palpation can detect pregnancy immediately, enabling appropriate therapeutic adjustments. However, a disadvantage of this method is that it requires considerable clinical experience from a veterinarian. The method is not suitable for rapid early diagnosis of twin pregnancies, assessment of fetal viability and sex (11). A comparison

Tab. 1. A comparison of selected methods of pregnancy detection in cows (Dahten C., Methods of pregnancy detection in beef cattle. 2013, <https://www.ag.ndsu.edu/pubs/ansci/beef/as1632.pdf>)

Features	Transrectal palpation	USG	Chemical test (PAG)
Minimum age of pregnancy [days]	35-40	25-30	28-32
Accurate assessment of fetal age	yes	yes	no
Diagnosis of twin pregnancies	no	yes	no
Assessment of fetal viability	no	yes	no
Assessment of fetal sex	no	yes	no
Necessary doctor	yes	yes	no
Immediate result	yes	yes	no
Clinical experience	yes	yes	no
Price	low	high	low

of selected methods of pregnancy detection in cows is presented in Table 1.

Diagnostic criteria, test technique and diagnostic measures

The purpose for examining cows for pregnancy is not to confirm pregnancy, but to detect those that are not pregnant so that they can be treated, inseminated again or culled from the herd (7, 30). The method involves palpation of the uterine through the rectal wall and identification of its content. Palpation is associated with a precise and gentle movement of the uterine horns along its entire length, between the thumb and the rest of the investigator's fingers. From the 30th day of pregnancy, a small asymmetry of the uterine horns appears, especially in heifers and young cows, it is possible to detect the embryonic vesicle, perceptible as a cupping extension of the uterus horn, with its wall becoming thinner (9, 10). However, these are not certain signs of pregnancy, and the diagnosis of pregnancy based on these symptoms may be fraught with errors. It is emphasized to conscientiously sweep both corners of the uterus along their entire length, from the bifurcation uteri to the tubal end. Sometimes, it is difficult because the uterus horns go down. In such cases, the pregnancy may remain unrecognized (false negative diagnosis). It is also possible to misidentify a non-existent pregnancy (false positive diagnosis), especially when there is fluid pathological content in the uterus (28, 30). Although a number of changes in the size, texture, location, fluid in the uterine lumen, middle uterine artery hypertrophy, presence of the mature corpus luteum on the ovary occur during pregnancy, there are only four positive signs of pregnancy that are detectable by rectal palpation, and the examiner must detect at least one of these four signs before declaring the cow pregnant. The four positive signs of pregnancy in cows are: 1) palpation of the chorioallantois using the fetal membrane "slip" method (FMS), 2) detection of the amniotic sac (AV), palpation of placentomas and palpation of the fetus

itself (30). The earliest appears a vesicle with amniotic fluid, which is recognized as an almost spherical, turgid, fluid-filled structure. Amniotic fluid is palpable as early as 28 days after conception in heifers and by 32 to 35 days in older cows (7, 30, 52). The diameter of the follicle is about 1 cm on the 28th day of pregnancy and it rapidly increases in size as pregnancy advances (30). Attempts to recognize pregnancy very early (20-25 after insemination) in cows based on the detection of the fetal sac showed that the diagnosis are accurate in less than 54%, while the examination carried out on days 30-35 was more than 80% accurate (28). Most false diagnoses referred to cows that were considered by the investigator to be pregnant, which was subsequently not confirmed in a later follow-up examination (28). In a bovine conceptus, the heart is external until approximately day 42, therefore caution must be exercised when attempting to detect early pregnancies and undue pressure must not be applied to the amniotic vesicle (6, 53). Intentional rupture of the amniotic vesicle was used in the past as a method to intentionally provoke abortion in cattle (5). Fetal membranes are equally delicate and thin at this time. They become noticeable around the 35th day of pregnancy (9). At this stage of pregnancy, a veterinarian can detect two of the four signs of pregnancy (30). An experienced veterinarian is able to detect chorioallantois (developing placenta) in the pregnant uterus by compressing the uterus between the thumb and forefinger, lifting the uterus, and then letting the horn slowly 'slip' from the grasp (grip on the fetal membranes). If the cow is pregnant, the chorioallantois can be felt to slip through the fingers just prior the uterine wall, which gives a characteristic symptom of the two-acts (the phenomenon of two-acts) (28). However, these early changes are not always clear, especially in multiparous. For this reason, they may not be recognized. Membranes can slip in the corner in which pregnancy develops already about 30 days after fertilization, but with high certainty can be found around the 35th day of pregnancy (30). From that moment, the palpation examination can be used to diagnose pregnancy until delivery (7, 30). Roche (39) draws attention to the much higher accuracy of rectal examination in the detection of non-pregnant cows of beef breeds as compared to the classic methods of estrus detection, or progesterone level on day 21 after time of artificial insemination. Detailed data of diagnostic measures of the most important methods of pregnancy diagnosis in cows is presented in Table 2. The table shows that 30-35 days after insemination, rectal examination is just as effective as modern techniques in pregnancy detection. There are at least several factors that determine the success of the rectal examination. The most important ones include the date of the examination, the examiner's experience – including the subtlety of the examination and the number of criteria included, the condition of the animal and others (7, 29).

Tab. 2. Detailed data of diagnostic measures of the most important methods of pregnancy diagnosis in cows

Method	Accuracy (%)	Specificity (%)	Sensitivity (%)	Positive predictive value (%)	Negative predictive value (%)	Authors
Rectal examination						
Single pregnancy						
31-35	37.5	90.9				Karen, 2011 (20)
45-50	93.8		96.0			
51-55	100	100				
in total	37.5-100	90.9-100				
Twin pregnancy	49.4	99.4		86.1		Day, 1995 (11)
USG						
in total	82	73	78.2	80.8	74.4	Racewicz, 2016 (37) Romano, 2006 (38)
21 (heifers)		87.5	50			
26 (heifers)		94	100			
24 (cows)		96.6	74.5			
27 (cows)		96.6	100			
PAG						
in total		95.5	99.2	99.8	80.8	LeBlanc, 2013 (26) Garmo, 2008 (17) Karen, 2007 (21)
57.6		94.6	94.3			
19-24		92.0	11.1			
31			100			
19-55		90.0-100	100			

The goal in rectal palpation is to be 100% accurate at determining the pregnancy status 35 days post breeding (35). Generally, the earlier the rectal examination for pregnancy is carried out, the greater the risk of confusion (30, 50). The sensitivity of TRP for detecting pregnant buffalo cows was 37.5% at days 31-35, increased to 93.8% at days 46-50 and reached 100% at days 51-55 (22). The average sensitivity, specificity, accuracy, and predictive value of twin pregnancy diagnosis were 49.3%, 99.4%, 96.0%, and 86.1%, respectively (11). The necessity of the veterinarian having clinical experience when performing rectal palpation was highlighted in many studies. Moreover, the animal category is of importance: in heifers the pregnancy was diagnosed with higher sensitivity and specificity than in primiparous and multiparous cows. The body condition of females (considerable diagnostic difficulties in cows in the fattening condition), the size of the rectum and the number of diagnostic criteria included in the examination also matter (30).

Stress and welfare of the cows tested

Recently, more and more often attention is paid to the negative impact of stress accompanying the palpation per rectum (PPR) and thus violating animal welfare.

Under current law, each breeding animal has the right to freedom, including the right to freedom from: hunger, thirst, pain, stress, injuries and diseases. Each clinical examination can cause stress in a cow, therefore the investigator should minimize this effect and not allow pain. Measurements of heart rate (HR) and heart rate variability (HRV) are considered as non-invasive methods for the assessment of autonomic nervous system (ANS) activity (23). Stimulation of this system occurs during stress and rectal examination is considered stressful. In one of the experiments, the heart rate was measured during the study in both lactating animals (LACT) and non-lactating cows

(NLACT). An increase in HR was detected during PPR in both LACT (+21.4 beats/min) and NLACT cows (+20.6 beats/min). However, the magnitude of the response to stress and its time was greater in cows in lactation than in nulliparous (24). Based on this research, it has been stated that the impact of PPR on stress reactions, including cows' heartbeats, may have some influence on animal welfare in dairy farms (24). In a small percentage of cows, repeated bleeds (e.g. for educational purposes or a brutal examination) may occur. In such cases, in order to take care of the cows welfare the need for as delicate an examination as possible is emphasized (31).

Loss of pregnancy as a result of per rectum examination

Some studies emphasize the increased risk of mechanical damage to the fetal membranes and fetus during pregnancy testing per rectum, especially when carried out before the 40th day after insemination. The reasons for miscarriage are divided into spontaneous, in which the completion of pregnancy occurs naturally (abnormalities of the fetus, uterus, maternal or genetic background) and artificial (due to human interference or mechanical injuries) (18, 28, 53). Generally, pregnancy losses are quite significant in modern cattle and often exceed 10% (1, 3, 11, 13, 15, 52). In north-east Poland, late embryonic and foetal losses was 5.0% (6). In the case of twins, they are even higher and can reach over 30% (27). Loss of pregnancy or abortion as a result of a clinical examination per rectum is extremely rare (43, 44, 47, 48, 50). However, some risk may be expected, especially in the case of an early pregnancy and – at least in theory – it may be greater than during a clinical examination per rectum using an ultrasound or control of the serum or milk level of PAG (16, 19, 21, 22, 25). Previous data indicate that in the case of palpation performed before the 35th day of pregnancy,

the loss may amount to 5.8%, while the diagnosis performed in 35-40 or > 45 is associated with losses in the range of 6.0 and 0.8% (43). A great deal of recent information on the possible invasiveness of palpation can be found in American studies (41-45). To verify the thesis concerning the impact of palpation on early and late pregnancy losses, a number of studies were carried out (41, 44, 45). In one of them, the pregnancy was diagnosed on day 34-43 solely on the basis of the palpation of the amniotic sac. The percentage of pregnancy losses compared to the control group between 46 and 60 days was 1.3 and 3.6, while in the period between 61 and 90 days, 1.4 and 0.6% (42). Similar results were obtained in two different herds of cows. The percentage of early pregnancy losses in herd A, after amniotic sac palpation between 34 and 45 days was 11.5 and 13.2%, while in B herd, 11.2 and 8.8%. The percentage of late pregnancy losses was lower in herd A, 7.6 and 5.5 for the control and test group, in the B herd respectively 3.7 and 6.3% (44). In both studies, the negative impact of the amniotic sac palpation on the size of early and late pregnancy losses was not confirmed. Similar effects were not noted when diagnosing pregnancy based on the fetal membrane "slip" method (FMS). In cows in which rectal examination was performed between days 34 and 41 of gestation, the percentage of embryo/fetal death was 14.7, while in the control group (no palpation per rectum) – 13.4% (41). Both the diagnosis by examining the amniotic membrane (fetal membrane slip (FMS)) and amniotic sac palpation (ASP) did not have a significant impact on the total percentage of calving rate (number of cows calved divided by the number of cows pregnant at re-examination) and did not increase the pregnancy loss (45). None of these studies had a significant impact on the percentage of early and late pregnancy losses and the number of dead calves (41, 44, 45). Prenatal mortality up to 100 days after palpation in pregnancies diagnosed less than 35 days after insemination, between 35 and 45 days and over 45 days was more frequent in cows with postnatal period disorders, in particular endometriosis (33). In a similar experiment comparing the invasive effect of the rectal examination in various types of cows it turned out that in the herd of beef cattle the percentage of pregnancy losses in heifers was significantly lower than in milk one and reached 1.55% if the rectal examination was carried out between 42 and 74 days after covering (52). In beef heifers tested for pregnancy at ≥ 53 days gestation or after, the percentage of pregnancy losses was 1.26%, but higher before this date, amounting to 3.46%. After rectal examination and ultrasound – 2.68 and 1.29% (38). In a subsequent experiment, blood was collected between 30 and 45 days after insemination, and evaluated for the presence of specific bovine pregnancy protein B (bPSPB) by the RIA method. Examination of the membranes was carried out by an experienced

veterinarian in about half of the fertilized heifers. To determine the survival of the embryos, another blood sample was collected approximately 60 days after the insemination from 1358 heifers, which were determined as pregnant on the basis of the first blood test. The average pregnancy loss was 5.3% in the period between the initial pregnancy diagnosis, between 30 and 45 days and its subsequent detection – on day 60. The loss of embryos in heifers was 6.5% compared to 4.3% in control heifers. These findings confirm that there was a significant loss of embryos between 30 and 60 days after insemination, but it did not occur as a result of a palpable pregnancy test (1).

The examiner's experience, repetitions and pregnancy losses

The examiner's experience and the multiple palpation pregnancy detection seem to have a marginal effect on the percentage of pregnancy losses (33, 38). Errors can occur as the result of inadequate training or skills, or a hurried examination (30). In one of the experiments, cows were examined by one of three veterinary students and one or more experienced veterinarians. Repeated palpation examination could have caused loss of pregnancy but their frequency did not justify changing the test technique or elimination of student palpators (33). In turn, in heifers examined palpatively by an inexperienced and experienced veterinarian, the percentage of pregnancy losses was 2.07 and 1.05% (38). At the same time, in large epidemiological studies carried out in the United States for nearly 20,000 cows, which were attended by a dozen or so veterinarians of free practice, it was established that the probability of pregnancy loss as a result of rectal examination after 6 weeks after insemination is irrelevant (50). It is also small if carried out between 28 and 42 days after insemination (50). However, from previous work it appears that if the time of palpation is prolonged as a result of detailed examination of three pregnancy features: palpation of fetal fluid fluctuation, identification of the amniotic vesicle (AV), and fetal membrane slip (FMS), the frequency of pregnancy losses can be as high as 10%, which is an unacceptable value (14).

Training of future veterinarians

Bovine palpation is an indispensable skill to teach veterinary students. Lack of animal accessibility to practice and welfare issues are currently limiting the number of student training in preparation for the profession. A good solution is an exercise stimulator – Bovine Rectal Palpation Simulator – developed to complement existing training methods. While using the simulator, the student senses artificial organs imitating the bovine reproductive system, receiving the feedback from the device (in the model of a glass fiber cow). The teacher has the ability to track the student's activity on the monitor and give instructions. The results of the

conducted experiment prove that supplementing the training with exercises on the simulator significantly affect the skills of students, in comparison with the control group that did not use phantom exercises (2-4).

The sensitivity of pregnancy diagnosis made by fourth-year (of a 6-year program) veterinary students, was lower than in the case of exercises on live animals (2).

The risk of transmission of pathogens and fetal trauma

The risk of pathogens transmission during the palpation per rectum examination was analyzed only in the few previous studies (25, 30, 46). It involved the transmission of a BLV virus (18) or BVD virus (25), as well as paratuberculosis and anaplasmosis (30). Some information on possible bacteraemia as a result of palpation per rectum was also provided (46). Most clinicians are aware that hemorrhage of the rectal mucosa can occur during palpation. It is likely that most cows experience some degree of hemorrhage during rectal examination, although it is usually not grossly detectable (30). In addition, some indicate an increased risk of developmental malformations, including colon atresia and intestinal strictures in calves as a result of the AV study (31). Recent studies, however, do not confirm these observations. Out of 680 cows examined, colon atresia was recorded in only two cows previously included in the control group (44).

Although research and development efforts are being made to develop indirect pregnancy tests in dairy cows, the early rectal palpation in cows, due to its numerous qualities, remains a viable and attractive alternative to ultrasound examination and glycoprotein concentration in milk or blood. It should be assumed that especially in smaller herds of dairy cows and in the study of heifers it will fully retain its current status. In large herds of cows it will probably be used in conjunction with other methods – mainly the assessment of the PAG level. The future will show whether – especially in large herds of cattle – these intermediate tests will be able to completely replace transrectal palpation or ultrasound as a basic method in diagnosing pregnancy in dairy cows, especially in the face of the loss of a certain percentage of early pregnancies (32).

In relation to a more advanced pregnancy, the rectal examination will still be – next to the ultrasound examination – the appeal method (32). However, it cannot be ruled out that, as some believe, future technologies for diagnosing pregnancy in cows may someday overcome current limitations of direct methods for pregnancy diagnosis, thereby improving reproductive performance and management of cows (15, 47).

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