Evaluation of transrectal examination of cervical diameter by palpation in dairy cows

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ABSTRACT

The objective of the study was to evaluate the reliability of a manual assessment of cervical diameter through palpation. In an in vivo trial, 64 Holstein-Friesian cows between 2 and 5 d in milk (DIM) and between 21 and 27 DIM were examined by transrectal palpation by 3 investigators. For calculation of sensitivity and specificity, ultrasound-generated measurements were used as reference standard; a cervix >7.5 cm was categorized as large. The Pearson coefficient of correlation between the results of the 3 investigators and ultrasound-generated measurements was moderate (r = 0.71, 0.74, and 0.51). The estimates generated by palpation by the 3 different investigators did not differ and were similar to measurements obtained by ultrasound. The coefficient of variation (CV) between the investigators and ultrasound was high (20.9, 18.7, and 32.0%). The mean difference between the investigators and the ultrasound was 0.60 cm (95% confidence interval: −2.4 to 3.6). Sensitivity was 28.6, 42.9, and 42.9%, and specificity was 100, 96.2, and 92.6% for the ability of the 3 investigators, respectively, to detect the 7.5-cm cutoff by palpation. Overall sensitivity and specificity for all 3 investigators, considering ultrasound as the reference, were 37.5 and 96.2%, respectively. In vitro, 24 wooden cylinders were used to represent cervical diameter and to examine the reliability, as well as sensitivity and specificity, of manual assessment of different diameters. The Pearson coefficient of correlation between the results of the investigators (n = 11) and the actual diameters of the cylinders was 0.78. The CV between the investigators and the cylinders was 27.8%. The variation in the results was greater for cylinders with a larger diameter (3.5-cm diameter: mean ± standard deviation = 2.6 ± 0.9 cm; 10.5-cm diameter: mean ± standard deviation = 13.2 ± 4.0 cm). The estimate obtained by palpation for the 7.5-cm cylinder was 7.4 ± 2.1 cm. Sensitivity was 79.4% and specificity 92.5%. After training one group of investigators, sensitivity and specificity improved to 85.9 and 94.4%, respectively. Transrectal palpation of the cervical diameter shows moderate repeatability and correlation and high variation between the investigators and the reference standards. Variability increased with larger diameters.
Key words: clinical endometritis, cervical diameter, diagnosis, test characteristic

INTRODUCTION

The negative effect of uterine diseases of postpartum cows on reproductive performance is well documented through several publications (e.g., McDougall et al., 2007; Runciman et al., 2008). One important postpartum uterine disease in dairy cows is clinical endometritis (**CE**). Two recent studies established a scientifically sound and clinically useful case definition of CE based on factors that are prognostic for impaired reproductive performance (LeBlanc et al., 2002a; Sheldon et al., 2006). Clinical endometritis is defined as a cervical diameter >7.5 cm determined by transrectal palpation after 20 DIM or as mucopurulent or purulent vaginal discharge by vaginoscopy after 26 DIM. Cows with CE have significantly decreased fertility (LeBlanc et al., 2002a). Recently, it was demonstrated that the likelihood of returning to cyclicity decreased for each 1-cm increase in cervical diameter measured by ultrasound between 15 and 21 d postpartum (López-Helguera et al., 2012).

The cervix is an important barrier against invasion of bacteria into the uterus (Bekana et al., 1996, 1997). Thus, cervical closure and regaining the firm structure of the cervix after parturition are important for reproductive performance (van Engelen et al., 2007). Besides purulent uterine discharge, delayed involution of the cervix is the only other predictive sign for reduced pregnancy rate, and it has been considered a simple and objective clinical finding for the diagnosis of CE (LeBlanc et al., 2002a).

Transrectal palpation of the uterus to assess its size lacks diagnostic accuracy, as large uteri may reflect physical damage or variations associated with breed, age, or nutrition (Dohmen et al., 2000; LeBlanc et al., 2002a; Sheldon et al., 2006). Kelton et al. (1991) al-

ready reported evidence of inter-clinician variability in the accuracy of assessment of corpus luteum presence by transrectal palpation. Currently, data are lacking on the repeatability of assessment of cervical diameter estimated by transrectal palpation. Therefore, the overall objective of this study was to determine the reliability of a manual assessment of the cervical diameter through transrectal palpation. Specifically, we set out to (1) evaluate the sensitivity and specificity using a reference standard, (2) determine the inter-observer repeatability, and (3) study the human ability to assess cylinders of known diameters through palpation by means of an in vitro experiment.

MATERIALS AND METHODS

In Vivo

The study was conducted on 2 dairy farms in Brandenburg, Germany, between July and December 2010. The herd size was 1,200 and 180 cows in herds A and B, respectively. The cows in herd A were housed year round in freestall facilities with cubicles, rubber mats, and slotted floors. They were grouped in pens holding approximately 100 cows depending on lactation and reproduction status. Calving pens were bedded with straw. Average milk yield was 10,050 kg/cow per lactation with 4.3% fat and 3.1% protein. A TMR was fed, consisting of 39.7% concentrate and mineral mix, 32.9% grass silage, and 19.2% corn silage (NE_L = 1.65 Mcal/kg).

The cows in herd B were housed in a deep-bedded barn. A TMR was fed but composition information was not available. Average milk yield was 9,482 kg/cow per lactation with 4.2% fat and 3.6% protein.

Before the study, an informed consent was obtained from both herd owners. Sixty-four cows were selected by a random allocation plan generated with PASW (PASW Statistics 18.0, SPSS Inc., Munich, Germany) and enrolled in the study between July and December 2010. Three independent investigators (**Inv**) examined cows between 2 and 5 DIM or between 21 and 27 DIM within 10 ± 3 min by transrectal palpation. The same 3 investigators were utilized throughout the study; to ensure independent results, each investigator documented his or her findings on case report forms without the other investigators present. The investigators were certified veterinarians, and their experience in transrectal palpation (i.e., >150 cows) was established by means of a questionnaire before the herd visit. To control the results obtained by palpation, the cows were also examined by ultrasound.

Four experiments were conducted. The objective of experiment 1 was to determine the intra-observer repeatability of cervical diameters determined by ultrasound conducted by the same investigator. From each cervix, 2 ultrasound images were recorded within 1 min, measured twice both vertically and horizontally using the internal caliper cow side, and stored on an internal drive. The investigation was conducted using a portable, battery-powered ultrasound device (Tringa, Esaote Pie Medical, Maastricht, the Netherlands), a linear transducer, and a probe frequency of 7.5 MHz.

Experiment 2 tested inter-observer repeatability of cervical diameters measured by ultrasound as described above. Two investigators examined the cows using transrectal ultrasound independently within 5 ± 2 min.

Experiment 3 compared the results of transrectal palpation with those determined by ultrasound. Three investigators (Inv 1, 2, and 3) examined cows by transrectal palpation to estimate the cervical diameter (cm) within 1 min and documented their results. The results of transrectal palpation were compared with values obtained through ultrasound examination by another investigator, as described in experiment 1. Sensitivity and specificity were calculated for Inv 1, 2, and 3 using the ultrasound results as reference standard.

In experiment 4, results of transrectal palpation by 3 different investigators (Inv 1, 2, and 3) were compared. The investigators assessed cervical diameter by transrectal palpation within 1 min.

In Vitro

An in vitro trial utilizing a reference standard was conducted to establish test characteristics of estimates of cervical diameter obtained through transrectal palpation and to study whether the ability to conduct a manual assessment could be improved by training. To create reference standards representing different cervical diameters, 24 wooden cylinders were custom-made. The cylinders were 20 cm long and ranged between 3.5 and 10.5 cm in diameter, in 0.3-cm increments. The cylinders were placed into a drainpipe (length = 57 cm, inner diameter = 15 cm) enclosed by a wooden box ($45 \times 25 \times 20$ cm). The investigators had to manually palpate the cylinders from above but could not access the cross section, which was hidden behind a crescent-shaped board located 20 cm from the rear end of the pipe. The author (C. Leutert) inserted the cylinders from the front end of the pipe and the investigators were located at the other end. Camouflage was attached to the box on the investigator side, which ensured that the investigators could palpate, but not see, the wooden cylinders.

In total, 10 replicates were conducted in 10 consecutive weeks with 11 investigators (final-year veterinary students). Per replicate, each investigator had to assess