

Mammary Gland Ultrasound Evaluation of Jersey Cattle Breed

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ABSTRACT

Background: Ultrasound allows the udder evaluation of lactating cattle, through parameters such as the area of the cistern of the mammary gland and teat, and can reveal structures with different echogenicity, indicating injuries as mastitis, edema, hematoma, abscess, atrophy and fibrosis in the mammary gland parenchyma. The aim of this study was to observe the clinical, morphometric and sonographic assessment of the mammary gland of Jersey cows, evaluating the correlation of this exam and the production of milk.

Materials, Methods & Results: Nine Jersey breed cows, aged 3 to 9 years, in a variable order of first to seventh lactation were evaluated. Animals were submitted to general and specific clinical examination of the mammary gland. For the evaluation, inspection and palpation of the gland cistern and teat cistern, measuring with tape measure the udder circumference and width and height of each mammary quarter was held, and length measurements of the four teats individually using a caliper. By palpation the mammary gland parenchyma was classified as nothing worthy of note and fibrosis. After this evaluation, the mammary glands were evaluated using ultrasound, analyzing biometrics and echotexture in order to detect and/or confirm possible changes identified in prior palpation. The diameter of the gland and teat cistern were measured, and the echogenicity of each region and each mammary quarter, checking the homogeneity of the parenchyma, evaluating the possible presence of nodules, scarring or acute injuries. The average milk production was 15.57 ± 5.4 L. There was no correlation between milk production, measured biometric data of the mammary gland and clinical and ultrasonographic changes ($P > 0.05$). On palpation exam, a few number of animals had soft to normal consistency in mammary glands (2/9), the occurrence of fibrosis was observed, but could only be detected by ultrasonography (4/9).

Discussion: Using the ultrasound examination is possible to access more accurately the morphology of the udder of lactating animals, examining and measuring the area of the cistern of the mammary gland and teat, the thickness of the wall and ceiling interface. Several studies correlate the morphology of these parameters with resistance to mastitis. The imaging aids to differentiate the teats according to animal age, milk production, lactation number, size, as well as a predisposition to mastitis. In healthy animals, the boundary between the gland cistern and teat cistern is marked by the presence of large anechoic structures. Changes in the teats of a gland with mastitis are mild inflammation, proliferation of tissues and mucosal lesions. No significant correlation between the morphology, physical examination and ultrasound changes of the mammary gland and milk production was observed. Possibly this was due to the limited number of experimental animals, and there is a wide variation in age and clinical profiles, as already observed in other studies that cows with high and wide rear udders tend to have higher milk production. In some cases ultrasound allows observe formation of gas, bruising, edema, abscess, atrophy, fibrosis, fistulae and intraluminal obstructions and parenchymal echogenicity changes during infection cases. In normal ultrasound examination, the parenchyma of the mammary gland must be homogeneous with high echogenicity and anechoic alveolus. Atresic and fibrosis are hyperechoic and lose the typical echogenicity of the udder. Thus, it is emphasized that ultrasound is a complementary method in the evaluation of the mammary gland, since it identifies not noticeable injuries on physical examination that may affect milk production.

Keywords: udder, mastitis, milk production, ultrasound.

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INTRODUCTION

Ultrasound is an imaging technique that allows the evaluation mainly of body soft tissue and is considered a non-invasive method that dynamically provides information about the shape, contours and architecture of a particular organ [11].

With advances in ultrasound modes it is possible to perform more precise examination of the morphology of the udder of lactating animals [14]. The exam can be used to estimate the area of the cistern of the mammary gland (GM) and teats, diameter, wall thickness and the length of the teats and the connection of these parameters with resistance to mastitis. Ultrasound examination can also reveal structures with different echogenicity, suggesting the occurrence of injuries as mastitis, edema, hematoma, abscess, atrophy and fibrosis, fistulae and intraluminal obstruction [10,11].

The aim of this study was to observe the clinical, morphometric and sonographic assessment of the mammary gland of Jersey cows, evaluating the correlation of gland biometry and the possible alterations in the mammary gland parenchyma, milk production and mastitis lesions.

MATERIALS AND METHODS

Experimental design

This study was developed in the Dairy Cattle Didactic Unit of State University Midwest - UNICENTRO, Guarapuava, PR, Brazil. Jersey breed cows ($n = 9$), aged 3-9 years, in a variable order of first to seventh lactation were evaluated. Animals were submitted to general and specific clinical examination of the mammary gland. For the evaluation, inspection and palpation of the gland cistern and teat cistern, measuring with tape measure the udder circumference and width and height of each mammary quarter was held, and length measurements of the four teats individually using a caliper. By palpation the mammary gland parenchyma was classified as NWN - nothing worthy of note and F - fibrosis.

After this evaluation, the mammary glands were evaluated using ultrasound¹, with convex probe, frequency of 6 MHz, it was analyzed biometrics and echotexture in order to detect and/or confirm possible changes identified in prior palpation. The diameter of the gland and teat cistern were measured, and the echogenicity of each region and each mammary quarter, checking the homogeneity of the parenchyma, evaluating the possible presence of nodules, scarring or acute injuries. Changes in the gland parenchyma

echotexture were classified as: 0 - normal, 1 - homogeneous parenchyma with few hypoechoic areas, 2 - points / hypoechoic areas, 3 - hyperechoic points 4 - heterogeneous parenchyma with hypoechoic, hyperechoic areas.

Statistical analysis

In order to establish a distribution of frequency of occurrence of udder lesions, data referring to the measurement and definition of the architecture of the mammary gland and the udder, and the analysis of echogenicity of each region and daily milk production were expressed as means + standard or sample frequency and subjected to analysis of variance (ANOVA) and Tukey's test ($P < 0.05$) in GraphPad Prism 4 statistical software. Linear regression test was also performed in order to verify if there was correlation between the variables.

RESULTS

The average milk production was $15.57 \pm 5,4L$, with maximum and minimum of 10 and 25 L, respectively. Biometrics data of the mammary gland are presented in Table 1, and the parameters of the assessment by palpation and ultrasound echotexture changes are presented in Table 2.

Table 1. Biometric parameters of the mammary gland of Jersey cows by physical examination and ultrasound.

Parameter	Max. (cm)	Min. (cm)	Mean (cm)
Udder circumference	130	100	117.28
Height fourth LR	49	33	39.85
Width fourth LR	13	7,0	10
Gland cistern LR	6.5	4.63	5.80
Teat cistern LR	1.76	0.6	1.31
Length of the ceiling LR	7.0	5.0	5.7
Height fourth RR	50	31	41.57
Width fourth RR	18	9	12.42
Gland cistern RR	8.32	3.82	6.59
Teat cistern RR	4.27	0,4	1,89
Length of the ceiling RR	8.5	4.5	6
Height fourth LF	32	23	26.28
Width fourth LF	14.2	10.2	12.02
Gland cistern LF	6.8	4.8	5.52
Teat cistern LF	2,46	0,8	1,70
Length of the ceiling LF	9	6.3	7.75
Height fourth RF	33	23	27.57
Width fourth RF	14.2	10.4	12.61
Gland cistern RF	8.53	3.57	5.55
Teat cistern RF	2.15	1.4	1.78
Length of the ceiling RF	9	6	7.55

LR: Left Rear; RR: Right Rear; LF: Left Fore; RF: Right Fore.

Table 2. Parameters of evaluation by palpation and ultrasound echotexture changes of the mammary gland of Jersey breed dairy cows.

Animal	LRP	RRP	LFP	RFP	LRE	RRE	LFE	RFE
1	NN	NN	NN	NN	0	0	0	0
2	NN	NN	NN	F	3	3	0	3
3	F	F	NN	F	2	0	0	2
4	F	F	F	F	4	4	4	2
5	F	F	F	F	2	4	2	4
6	NN	F	NN	F	2	4	4	2
7	F	F	F	F	3	2	4	2
8	NDN	NDN	NDN	NDN	0	3	2	0
9	F	NDN	NDN	NDN	4	2	0	0

LRP= Left Rear Palpation; RRP= Right Rear Palpation; LFP= Left Fore Palpation; RFP= Right Fore Palpation; LRE= Left Rear Echotexture; RRE= Right Rear Echotexture; LFE= Left Fore Echotexture; RFE= Right Fore Echotexture; NN= Nothing Noteworthy; F= Fibrosis; 0= Normal; 1= Homogeneous parenchyma with few hypochoic areas; 2= hypochoic points / areas; 3= Hyperechoic points; 4= Heterogeneous parenchyma with hypochoic, hyperechoic and anechoic areas.

The frequency and transducer type were efficient to observe all portions of the gland parenchyma and other structures such as cistern and wall thickness of the gland and teat, requiring no apparatus or bulkhead for the exam.

There was no correlation between milk production, measured biometric data of the mammary gland and clinical and ultrasonographic changes ($P > 0.05$).

DISCUSSION

Some methods are recommended to diagnose mastitis in dairy herds, in addition to physical examination of the mammary gland. Laboratory tests such as wired cup test, California Mastitis Test (CMT) and the Somatic Cell Count (SCC) [4]. However, with the advancement of technology in veterinary medicine, other methods of diagnosis of mastitis were emerging, such as ultrasound of the mammary gland [3].

The 6 MHz convex sector transducer was efficient for udder and mammary gland parenchyma evaluation. Afforded a broad view of the structures, efficient as much as or even better than the linear transducer also routinely used in this test [7].

Direct examination without bulkhead, only using the ultrasound gel was effective in the exam. However, it is reported that besides the direct examination, the use of silicone pad also has greater applicability, considering its ease use in routine added to complement clinical examination. Nevertheless, polyps and milk calculus presents their extent and location conveniently visualized by the use of liquid into the teat canal (liquid pressure technique). In turn, the structures immersion

technique in water seems to be more efficient as the quality of the images obtained and the characterization of anatomical structures [13].

Using the ultrasound examination it is possible to access more accurately the morphology of the udder of lactating animals, examining and measuring the area of the cistern of the mammary gland and teat, the thickness of the wall and ceiling interface. Several studies correlate the morphology of these parameters with resistance to mastitis [8].

For the teat exam it was not required to immerse in water or gel [10]. The mucosa of the cistern and wall were well delimited, allowing a perfect view of the examined organ. Most authors claim that the manipulation of the teat and the incorrect technique of milking, cause a decrease in milk production [8].

The imaging helps to differentiate the teats according to animal age, milk production, lactation number, size, as well as a predisposition to mastitis. In healthy animals, the boundary between the gland cistern and teat cistern is marked by the presence of large anechoic structures. Changes in the teats of a gland with mastitis are mild inflammation, proliferation of tissues and mucosal lesions. During the ultrasound, the teat wall presented a larger diameter and stenosis of the channel [7]. There were no changes diagnosed in the channel diameter or wall thickness, similar to Celik *et al.* [5]. The slight increase observed was due to the evaluation held postmilking [8].

The morphometry of the udder of Jersey cows had smaller size compared to Holstein cows and Girolanda, which was already expected since they are smaller.

No significant correlation between the morphology, physical examination and ultrasound changes of the mammary gland and milk production was observed. Possibly this was due to the limited number of experimental animals, and there was a wide variation in age and clinical profiles, as already observed in other studies that cows with high and wide rear udders tend to have higher milk production [5,12]. Amaral and Escrivão [1] also mentioned the existence of a positive correlation, although it is known that there are other factors such as genetic merit and size of the gland cistern that also influence the amount of milk produced [9].

In this study, during palpation, some animals had a soft consistency (normal) in mammary quarter, with most animals presenting a firm ranging to fibrous consistency in at least one of the mammary glands (7/9) [2].

None of the animals showed clinical mastitis in acute phase, only earlier chronic lesions, some not detected on clinical examination, only by ultrasound. In some cases ultrasound allows observe formation of gas, bruising, edema, abscess, atrophy, fibrosis, fistulae and intraluminal obstructions and parenchymal echogenicity changes during infection cases [7,10,11]. When gram negative bacteria are present, greater tissue damage with abscess formation, especially when *E. coli* is present in the tissue, initially the parenchyma is hyperechoic and gas formation is observed. Even though when we have the presence of gram-positive bacteria such as *Staphylococcus* and *Streptococcus* spp., the changes are less aggressive [6,7].

In normal ultrasound examination, the parenchyma of the mammary gland must be homogeneous with high echogenicity and anechoic alveolus. Atresic and fibrosis are hyperechoic and lose the typical echogenicity of the udder [11].

In this study, although not statistically significant correlation was observed, there were areas showing fiber consistency during palpation, on ultrasound exam were hyperechoic, suggesting chronic course, and extent of fibrosis, forming acoustic shadow. It is noteworthy that some ultrasound findings were not detected on physical examination, especially the character still acute or lesser degree of injury.

CONCLUSION

Even with a limited number of animals, the data on the morphology of the Jersey breed can contribute in biometric studies of mammary gland. Ultrasound examination proved efficient in the mammary gland exam in cattle, complementing the findings on physical examination, identifying lesions that are not obvious without this image feature. No correlation of morphometric data was observed, in the ultrasound, physical examination and milk production, possibly because of the limited number and low variable of samples. Even existed other variables that may influence the milk production, the chronic lesions, possibly are the responsible for the low milk production.

MANUFACTURER

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Declaration of interest. The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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