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Comparison of pulmonary ultrasound aspects of dairy calves born from a normal or dystocic parturition

Comparação dos aspectos ultrassonográficos pulmonares de bezerras leiteiras provenientes de parto normal e distócico

Comparación de los aspectos de la ecografía pulmonar de terneras lecheras nacidas de parto normal y distócico

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Abstract
Ultrasound has relatively low use in the veterinary practice of cattle, especially in the diagnosis of respiratory diseases. There is little information on imaging patterns and occurrence of these diseases in calves from dystocic parturition, especially in the ability to diagnose the subclinical respiratory diseases. The correct clinical diagnosis aims to support efficient growth and expression of genetic potential for the replacer calves. Eighteen Holstein calves, five of which did not require assistance during birth and thirteen calves from dystocic parturition had the respiratory system evaluated by ultrasound. The objective was to describe and compare the pulmonary ultrasound aspects of calves from dystocic parturitions, compared to calves born without any aid. The degree of dystocia was classified on a scale from 1 to 5 points and the categorization of ultrasound images considered the presence or absence of pulmonary lesions. The ultrasound examination was able to diagnose animals affected with BRD in a subclinical manifestation, considering that none of the animals that presented pulmonary consolidation showed clinical signs of respiratory diseases. All cows with dystocia were classified as grade 2 dystocic parturition. There was no correlation between normal delivery (grade 1) and mild dystocia (grade 2) and occurrence of pulmonary consolidation.
Keywords: Bovine; Veterinary practice; Disease; Lungs; Ultrasound.

Resumo
A ultrassonografia apresenta-se de certa forma negligenciada na clínica médica de bovinos, especialmente no diagnóstico de doenças respiratórias dos bovinos. Há pouca informação sobre padrões imaginológicos e ocorrência dessas doenças em bezerras provenientes de parto distócico, principalmente na capacidade de diagnóstico da forma

subclínica desses acometimentos pulmonares. O diagnóstico clínico correto visa crescimento eficiente e expressão do potencial genético para reposição do rebanho. Dezoito bezerras holandesas lactentes, sendo que cinco delas não necessitaram de auxílio durante o nascimento e treze bezerras provenientes de parto distócico tiveram o aparelho respiratório avaliado através de ultrassonografia. O presente trabalho foi desenvolvido em fazenda comercial produtora de leite localizada em Boa Esperança- MG, e objetivou descrever e comparar os aspectos ultrassonográficos pulmonares de bezerras provenientes de partos distócicos, comparativamente a bezerras nascidas sem auxílio. O grau de distocia foi classificado em escala de 1 a 5 pontos e a categorização de imagens ultrassonográficas considerou presença ou ausência de lesões pulmonares. O exame ultrassonográfico foi capaz de diagnosticar animais acometidos com DRB de forma subclínica, considerando que nenhum dos animais que apresentaram consolidação pulmonar, manifestaram sinais clínicos de doenças respiratórias. Todas as progenitoras que apresentaram distocia, foram classificadas como parto distócico grau 2. Não houve correlação entre parto normal (grau 1) e distocia leve (grau 2) e ocorrência de consolidação pulmonar.
Palavras-chave: Bovino; Clínica; Doença; Pulmão; Ultrassom.

Resumen
La ecografía es algo subestimada en la clínica médica bovina, especialmente en el diagnóstico de enfermedades respiratorias en bovinos. Hay poca información sobre los patrones de imagen y la aparición de estas enfermedades en terneros nacidos de parto distócico, especialmente en la capacidad de diagnóstico de la forma subclínica de estos trastornos pulmonares. El diagnóstico clínico correcto tiene como objetivo el crecimiento eficiente y la expresión del potencial genético para el reemplazo del rebaño. Dieciocho terneras lactantes holandesas, cinco de las cuales no necesitaron asistencia durante el parto y trece terneras nacidas de parto distócico, fueron tuvieron su sistema respiratorio evaluado por ecografía. El presente trabajo se llevó a cabo en una finca lechera comercial ubicada en Boa Esperança-MG, y tuvo como objetivo describir y comparar los aspectos ecográficos pulmonares de terneras nacidas de partos distócicos, en comparación con terneras nacidas sin asistencia. El grado de distocia se clasificó en una escala de 1 a 5 puntos y la categorización de las imágenes ecográficas consideró la presencia o ausencia de lesiones pulmonares. La ecografía logró diagnosticar animales afectados con ERB de forma subclínica, considerando que ninguno de los animales que presentó consolidación pulmonar presentó signos clínicos de enfermedades respiratorias. Todas las madres que presentaron distocia fueron clasificadas como parto distócico grado 2. No hubo correlación entre el parto normal (grado 1) y la distocia leve (grado 2) y la aparición de consolidación pulmonar.
Palabras clave: Bovino; Clínica; Enfermedad; Pulmón; Ecografía.

1. Introduction

Despite the constant growth of dairy cattle industry in Brazil, milk is still an undervalued product, so producers need constant cost reduction measures and increase in scale production. Profitability in dairy production is related amongst other factors to animal health and welfare, considering that cow replacement represents the second highest cost in dairy business. All considerations on a breeding programme may influence the future performance of dairy heifers, which are usually used as replacement of adult cows in the herd (Bach, 2011; Dunn et al., 2018; Dubrovsky et al., 2020). The need to replace cows that were discarded early from the herd can be met considering the proper management in the breeding of the new generation of dairy heifers.

In addition to metabolic diseases that can affect the health and production of a postpartum primiparous bovine female, there are studies that show lowest productive performance due to bovine respiratory diseases (BRD), which can then affect the animal during its growing period, affecting development and subsequent expression of genetic potential (Buczinski et al., 2014). Thus, there is a higher risk of culling even before the first parturition due to lower daily weight gain (GPD), (Schaffer et al., 2016) and lower milk production (Dunn et al., 2018). The occurrence of BRD in calves is related to inadequate peripartum management of the cow, mainly related to occurrences of dystocia. Epidemiologically, BRD and infectious diarrhea are among the main causes of death in dairy calves (Buczinski et al., 2016). In the control of these respiratory diseases, the appropriate sanitary and nutritional management of calves is essential, considering that this disease, in addition to compromising the growth of the animal, increases the costs of rearing. In this context, the correct diagnosis of BRD should be the objective of every veterinarian.

Although there are several diagnostic methods to evaluate the respiratory system, such as auscultation, radiography,

percussion or even ultrasound, according to Cramer and Ollivett (2019), only the latter can diagnose the subclinical form of diseases through the detection of lesions or pulmonary consolidations. Pulmonary ultrasonography in cattle is uncommon in the diagnosis of BRD, especially in the detection of the occurrence of diseases in calves from dystocic delivery. The study aimed to describe and compare the pulmonary ultrasound aspects of dairy calves from dystocic parturitions, compared to those born without any support. All experimental animals belonged to a commercial dairy farm in the municipality of Boa Esperança- MG, Brazil.

2. Methodology

The ethical principles and good practices for animal welfare related to the use of animals in experimentation were compliance with and approved by the Ethics Committee on the Use of Animals - CEUA, from UNILAVRAS, under protocol no.: 003/2019, 04/24/2019. The project was developed in a commercial dairy farm located in the municipality of Boa Esperança, State of Minas Gerais, Brazil.

2.1 Animals, Facilities, Dystocia and Performance Assessment

The Holstein dairy calves used in the experiment (n=18) were accommodated in an individual calf house. They were fed milk twice a day and received *ad libitum* concentrate for this growth phase. Among the calves, five did not require assistance during birth and thirteen came from dystocic parturition.

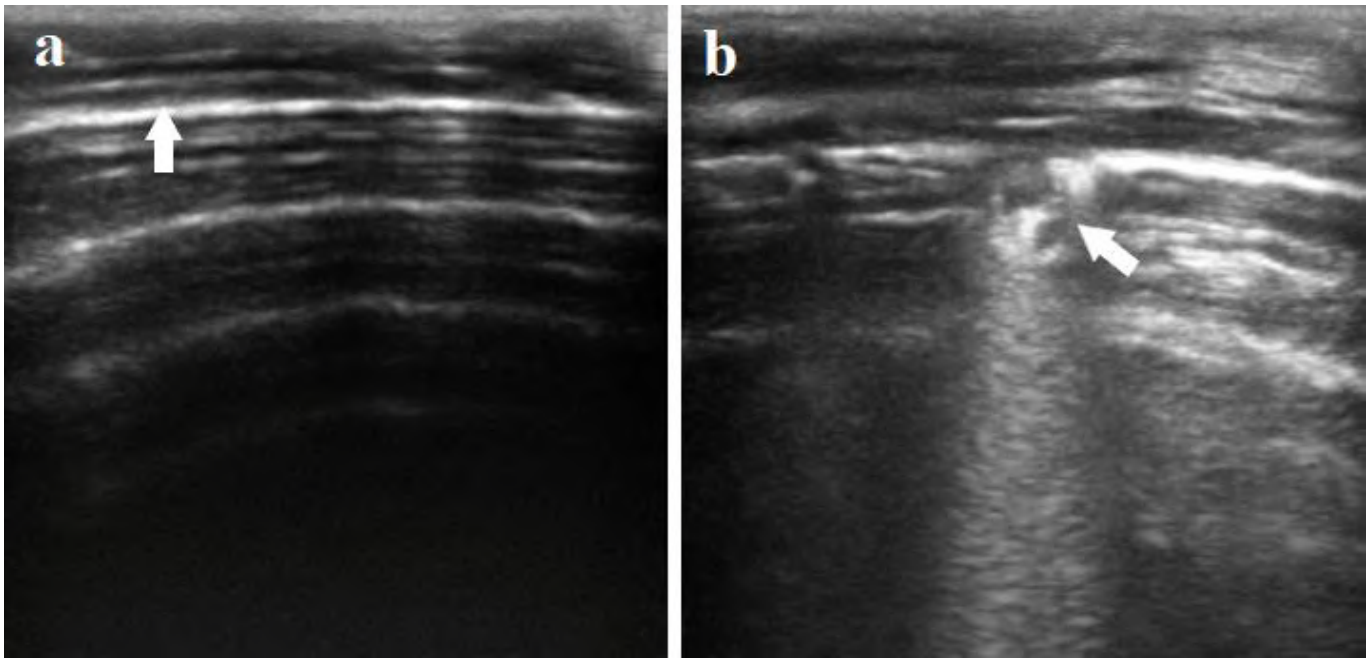
The score of dystocic parturition and parturition without assistance was evaluated according to the model proposed by Djemali et al. (1987). Grade 1 was assigned to animals that did not require assistance during parturition; Grade 2 defined as the parturition that required intervention by a person, without mechanical assistance (mild assistance); Grade 3 was attributed to any parturition that required assistance from 2 or more people (assistance required); Grade 4 was given for parturitions that required mechanical extraction (considerable strength) and Grade 5 was assigned to parturitions that required surgical intervention, in other words, when C-section was required. In addition to the dystocia classification, the parity of dairy cows was evaluated, divided into primiparous and multiparous (first parturition and second or more parturitions, respectively), testing whether there is a relationship with the occurrence of respiratory diseases in dairy calves.

After the selection of the apparently healthy calves, measurements of some physiological parameters were performed: temperature, heart rate and respiratory rate. In addition, a detailed anamnesis was performed to obtain information relevant to the study, mainly regarding the life history of the newly born calves and search for information recorded in the zootechnical database of the farm. After the measurements, the animals were submitted to ultrasound evaluation of the respiratory system, with emphasis on the lungs. The equipment used for the examination was a portable Ultrasound model M-Turbo® equipped with a multifrequency linear veterinary transducer. To improve the contact between the transducer and the skin, and to facilitate the transmission of sound, 70° liquid alcohol was used during ultrasound scanning.

Ultrasound evaluations of the lungs were performed in the animals in two moments, when they were aged 10±4 days and 40±4 days, respectively. The evaluation pattern followed the pulmonary consolidation scoring model described by Ollivett et al. (2011) and adapted by Teixeira et al. (2017). Thus, pulmonary ultrasound evaluation was performed by screening the intercostal spaces (ICS) in the dorsoventral direction, from the 2nd to 10th ICS (right antimer) and from the 3rd to the 9th ICS (left antimer). In the visual evaluation of the images, pulmonary consolidation was defined as pleural discontinuity with any heterogeneous hypoechoic area, and pulmonary normality considered characteristics such as aerating lung tissue and continuous or hyperechoic pleural line. In addition, reverberation artifacts were commonly observed, which according to Teixeira et al. (2017), are referred to as comet tail, hyperechoic structure in the vertical direction. In this context, the acquired images were classified on a 2-point scale (Figure 1), considering: AC (Absent Consolidation); PC (Present Consolidation).

Digital images (photos and movies) were stored on a microcomputer shortly after the examination.

Figure 1- Model of the pulmonary ultrasound imaging of dairy calves. Figure a- white arrow= continuous pleural line, i.e., absent pulmonary consolidation (AC). Figure b- white arrow= discontinuity of pleural line demonstrating presence of pulmonary consolidation (PC).



Source: Authors (2022)

2.2 Statistical Analysis

The group of calves with a history of birth from dystocia was compared to the group of calves born without assistance, in order to describe possible alterations in relation to normal pulmonary ultrasound parameters. Thus, the data collected during the two evaluations of the study were later statistically analyzed using Minitab 20® (Minitab Inc, Pennsylvania, USA). The analysis of variance was performed through the One-Way ANOVA. Data was tested for homogeneity of variance and normality of residues, in order to confirm validity of analysis. Significant differences were considered from $p<0.05$.

3. Results

During both evaluations, the calves were 10±4 days and 40±4 days old, respectively. The individual clinical and ultrasound parameters found during pulmonary scans were analyzed and described considering the presence or absence of pulmonary consolidation (Table 1). Eighteen animals received the first evaluation, and five calves did not require assistance during birth (grade 1 dystocia) and thirteen came from grade 2 dystocic parturition (mild dystocia). There was no grade 3, 4, or 5 dystocic parturition. In the period between the first and second evaluations, two calves died and no necropsy was performed. One of the calves was born from a twin parturition.

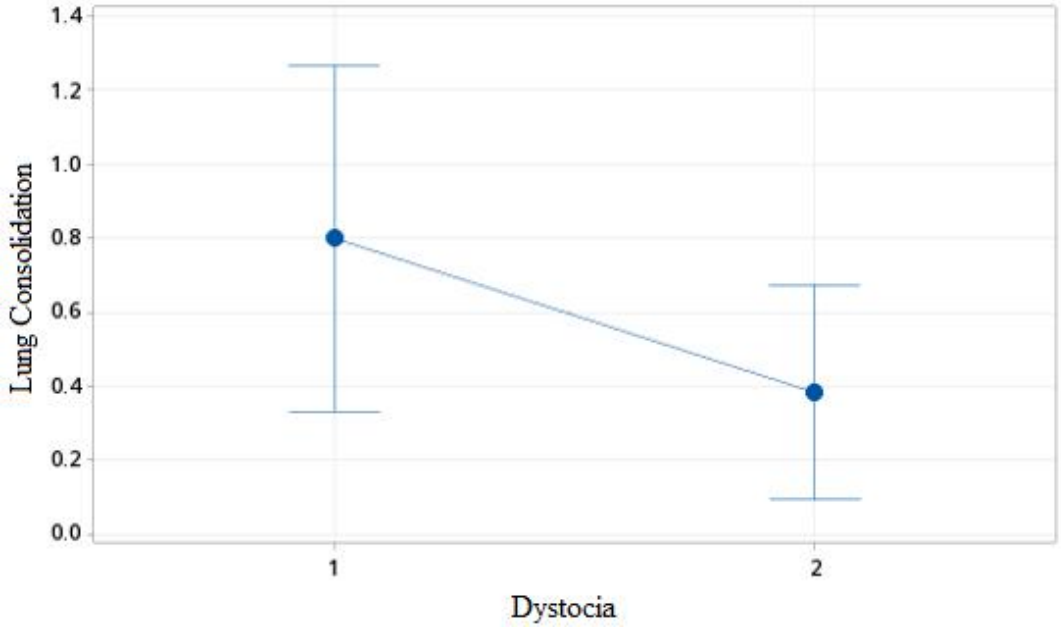
Table 1 - Data on clinical and ultrasound evaluation of dairy calves

Variable	Dystocia	N	Mean + SD	MSE	Minimum	Maximum
1° Evaluation						
Parity	1	5	1,80± 0,45	0,20	-	-
	2	13	1,54± 0,52	0,14	-	-
Age	1	5	8,00± 1,87	0,84	6,00	10,00
	2	13	10,62± 3,88	1,08	6,00	15,00
Temp	1	5	38,82± 0,38	0,17	38,20	39,20
	2	13	38,98± 0,40	0,11	38,60	40,10
Consolidation	1	5	0,80± 0,45	0,20	-	-
	2	13	0,39± 0,51	0,14	-	-
Comet tail	1	5	0,40± 0,55	0,25	-	-
	2	13	0,62± 0,51	0,14	-	-
2° Evaluation						
Age	1	5	38,00± 1,87	0,84	36,00	40,00
	2	11	41,45± 3,62	1,09	36,00	45,00
Temp	1	5	38,58± 0,13	0,06	38,40	38,70
	2	11	38,62± 0,30	0,09	38,10	39,00
Consolidation	1	5	0,40± 0,55	0,25	-	-
	2	11	0,55± 0,52	0,16	-	-
Comet tail	1	5	0,40± 0,55	0,25	-	-
	2	11	0,46± 0,52	0,16	-	-

Descriptive analysis of clinical and ultrasound data of the two evaluations performed in the study. Variables: Temp: Temperature (°C); Comet Tail. 1= Absent Dystocia (grade 1 dystocic parturition); 2= Present Dystocia (grade 2 dystocic parturition). Mean+SD= Mean+ Standard Deviation. MSE= Mean Standard Error. Source: Authors.

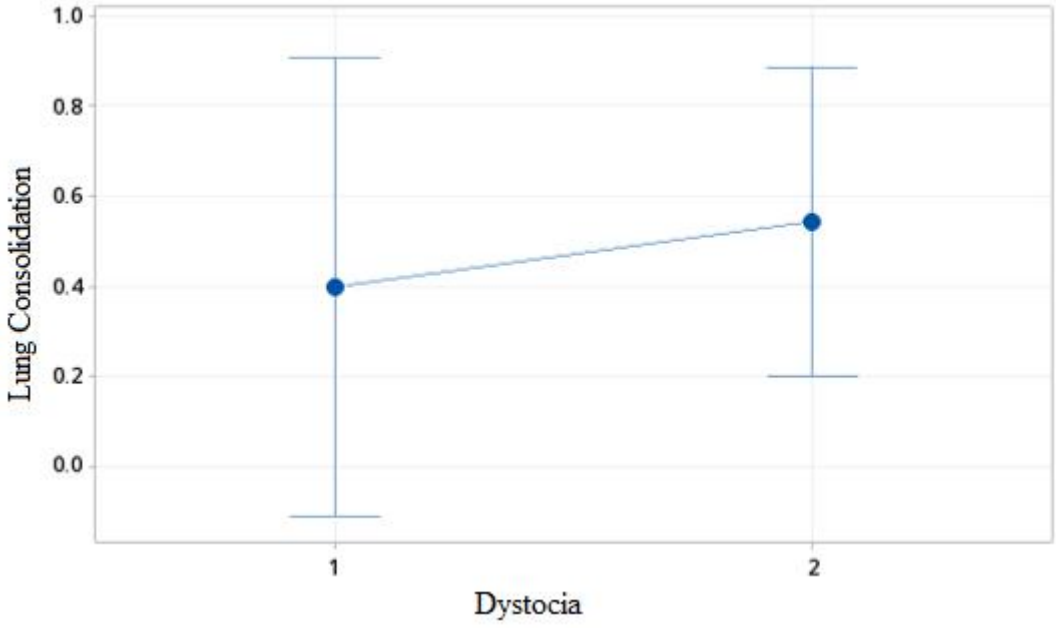
In the first ultrasound evaluation, 80.0% (4/5) born from a parturition without assistance presented pulmonary consolidation, and 38.5% (5/13) from grade 2 dystocia, presented pulmonary consolidation detected by ultrasound (P=0.13) (Figure 2). In the second ultrasound evaluation performed in the study, 40.0% (2/5) of the calves from normal parturition presented pulmonary consolidation, while 54.5% (6/11) born of dystocia grade 2 parturition presented pulmonary consolidation (P=0.6) (Figure 3).

Figure 2 - Consolidation vs. Dystocia in the 1st pulmonary ultrasonography. 1= Absent Dystocia (grade 1 dystocic parturition); 2= Present Dystocia (grade 2 dystocic parturition). Consolidation= Average number of consolidations in the lungs.



Source: Authors (2022).

Figure 3 - Consolidation vs. Dystocia at 2nd pulmonary ultrasonography. 1= Absent Dystocia (grade 1 dystocic parturition); 2= Present Dystocia (grade 2 dystocic parturition). Consolidation= Average number of consolidations in the lungs.



Source: Authors (2022).

It is important to analyze the data presented in the graphs referring to the two ultrasound evaluations performed in this study. Demonstrating that the presence of grade 1 and 2 dystocia was not correlated with the occurrence of BRD in calves in the first weeks of life.

4. Discussion

Bovine respiratory diseases (BRD) are most often not diagnosed correctly, considering the variety of clinical signs and factors that can lead to the development of these conditions (McGuirk, 2008). Therefore, clinical veterinarians working on dairy farms should use effective tools in order to avoid a large number of cases that are not diagnosed. It is important to highlight that the ultrasound evaluations of this study were performed by the same ultrasound device used in the reproduction of cattle.

The present study showed sufficient data to evidence the efficacy of pulmonary ultrasonography in the diagnosis of BRD, consistent with the results found by Jung & Bostedt (2004), Buczinski et al. (2013), Adams & Buczinski (2016), Buczinski et al. (2018), Cramer & Ollivett (2019) and Rhodes et al. (2021). These studies have shown that pulmonary ultrasound examination of dairy calves has considerable efficacy in the diagnosis of respiratory diseases. Similarly, Rabeling et al. (1998) evaluated lung lesions that were confirmed at necropsy and estimated ultrasound specificity and sensitivity around 86 to 94% and 98 to 100%, respectively.

The diagnosis of BRD is limited by the clinical or subclinical manifestation of diseases (Cramer & Ollivett, 2019; Quick et al., 2020), considering the high number of subclinical cases (Thompson et al., 2006; Dubrovsky et al., 2020) and the variety of symptoms that can be manifested by affected animals (Buczinski et al., 2016). During the two evaluations performed in this study, nine cases of BRD were diagnosed in the first ultrasound evaluation and eight cases in the second evaluation. All animals that presented pulmonary consolidation on ultrasound examination did not present clinical signs of BRD, i.e., ultrasound was able to detect the subclinical form of respiratory diseases. The correct ultrasound diagnosis has high relevance in the veterinary practice of dairy cattle, contributing to the establishment of appropriate treatment strategies and rational use of antibiotics (Adams & Buczinski, 2016; Jourquin et al., 2022), in addition to providing health and well-being to animals.

The evaluation of the history of the birth of the calves showed that all thirteen parturitions that required assistance were classified as dystocic delivery grade 2, in which there was assistance of only one person (mild dystocia), according to the classification proposed by Djemali et al. (1987). There are few imaging patterns of respiratory disease evaluation present in the literature and no information related to the occurrence of BRD correlated with dystocia was found. Therefore, the correlation analysis of the data of the ultrasound evaluations showed that the presence of pulmonary consolidation in dairy calves was not correlated with grade 1 and 2 dystocia. The results may have been influenced by the size of the sample evaluated, and the fact that there were no grade 3, 4, or 5 dystocic parturitions during the study development.

5. Conclusion

Ultrasound evaluation is an efficient method for detecting pulmonary consolidations and confirming respiratory diseases of cattle manifested clinically or subclinically. The study showed that both calves born from dystocic grade 2 delivery, and calves that did not require assistance during birth (grade 1), did not present correlation with the occurrence of BRD. Ultrasonography is of great importance in the veterinary practice of cattle, contributing to the appropriate clinical diagnosis and treatment plan, in order to provide health and well-being to the animals. The study serves as a basis for the development of scientific projects with a higher number of animals that can evaluate severe dystocia, besides the possibility of assisting in the establishment of ultrasound imaging patterns in the evaluation of pulmonary consolidation in dairy calves. It is suggested that future research characterize the pulmonary lesions observed in the ultrasound images and monitor the clinical evolution of the animals, considering the effect caused by chronic respiratory diseases in the performance of dairy calves.

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