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Detection of Lung Lesions by Ultrasonography Technique in Buffalo Calves

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BACKGROUND: Bovine Respiratory Disease is complex, multifactorial diseases process cause mortality in buffalo calves. Early diagnosis of such conditions could be difficult with the absent of noticeable clinical signs. Ultrasonography examination is a noninvasive tool that has been used frequently in the thoracic diagnosis of buffalo and cattle calves.

Objective: The aim of this study was to detect and assess the lung lesions in buffalo calves using ultrasonography examination.

Methods: The study included examination of 130 local buffalo calves divided into (100) calves showed respiratory symptoms including coughing, lacrimation, nasal discharge, general weakness, fever, and (30) clinically healthy calves as a control group, during the period from November 2021 until April 2022, their ages ranged between (2-6) months and from different areas in Mosul city.

Results: The results indicated that most of the infection was of the severe type (84%), and (16%) was mild infection. Moreover, calves with age ≥90 days are mostly affected, and the severity of infection was assessed (≥4) with rate of (54%), while the least infection was at the ages of <90 days. Results from ultrasound examination showed different pulmonary lesions, including irregular pleura (94%), comet-tail artifact (78%), alveologram (72%), while the lung consolidation was the least (33%). **Conclusion**: The ultrasound was highly accurate in diagnosing the type and severity of the lung lesion compared to the recording of clinical signs ,and proved the presence of respiratory tract diseased in buffalo calves.

Keywords: Ultrasound, Clinical score, Lung lesions, Buffalo Calves.

Introduction

Bovine Respiratory Disease affects the respiratory system and leads to complex inflammatory processes and is considered one of the most important causes of death in calves, moreover leads to economic losses as a result of the deterioration of the animal's health condition, furthermore to the difficulty of rapid detection of advanced cases and the heavy use of antibacterial [1].

The disease is characterized by the appearance of clinical symptoms that vary according to the stage of the disease and according to the age of the calves, and these symptoms include coughing, high fever, nasal discharge, lacrimation and emaciation [2].

Cough is one of the most clinical signs associated with the disease, while the rectal temperature may reach ≥ 39.4°C and the severity of bovine respiratory disease ranges from subclinical inflammation to life-threatening pneumonia [3]. Registration of signs is one of the methods of diagnosis and follow-up of disease, and there are many clinical respiratory score systems such as (Wisconsin or California respiratory scores),

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although they have the best ideal definition of the case [4, 5]. However, the diagnostic accuracy of these score systems is considered medium [6]. The use of a stethoscope in clinical examination of the respiratory system helps in early diagnosis of types of lung diseases and lesions, but the use of ultrasonography of thorax in the field is considered the most accurate diagnostic test in diagnosing lung diseases in calves [7, 8].

Through ultrasound examination of the lungs of diseased calves, various lesions were observed, namely, comet-tail artifact, accumulation of pleural fluids, irregular pleural thickness, and lung consolidation where the comet-tail was observed from the pleural membrane to the deepest part by ultrasonography during chest examination [9, 10].

In chronic cases, the lung appeared in the form of echogenic patterns with a penetration of less than (1 cm), and this indicates the consolidation of parts of the surface tissue of the lung [11].

By examining the diseased calves, the lung tissue appeared to be abnormal if it was comet-tail artifact and consolidation or appears in the form of an echogenic pattern, while the comet-tail artifact are very bright light currents that are dispersed by the propagation of sound waves [12]. The artifact arises from small consolidation of the lung on the surface or from irregularity of the visceral pleura, the alveologram appear as hypoechoic small area about (7mm) from lung surface result from accumulation of fluid in the alveoli, the consolidation appears on ultrasound in the form of echogenic area with radiating artifacts obstructing the normal reflex of the visceral pleural membrane and this is due to areas of consolidated tissue on the surface of the lung, The echo pattern in the picture is characteristic of lung tissue affected by pneumonia [13-16].

Materials and Methods

Animal of study

The study included the examination of 130 local buffalo calves divided into (100) calves showed respiratory signs including coughing, lacrimation, nasal discharge, general weakness, fever, and (30) clinically healthy calves as a control group, during the period from November 2021 until April 2022 by cross sectional method, their ages ranged between (2-6) months and from different areas in Mosul city.

Clinical examination

The case history, clinical signs which included (body temperature heartbeats breathing frequency "cycles/min", color of the mucous membrane, corneal capillaries and the rate of SpO2 and auscultation of breathing sounds with a stethoscope) were recorded.

Ultrasound examination

The animals were examined in a standing position after controlling the animal and without using anesthesia. The chest area was prepared on both sides (right and left) from the distance between ribs 3 to 8, hair was cut and alcohol was applied to remove fat, and then gel was applied according to Ollivett and Buczinski [8]. A portable ultrasound device (KX5100vet) and a Micro-convex probe with a frequency of 5.0 MHz were used, and the examination was conducted in four different places, and lung images were taken and saved on the hard disk for analysis of the results.

Statistical Analysis

We used the SigmaPlot program to analyze the parametric data and detect the ratio of Data, descriptive statistics was used to sum the values.

Results

The results of the current study showed that most of the infections were of the severe type, with a clinical degree ≥ 4, by (84%), while (16%) were suffering from mild infections, (Table 1).

The study revealed that most of the affections were at the age ≥90 day, and the severity of infection was assessed (≥4) at a rate of (54%), the severity of infection was assessed (<4) at a rate of (14%), the lower affection was at the age of <90 day. The severity of the disease was assessed (≥4) at a rate of (30%), and the severity of the disease was evaluated by (<4) at a rate of (2%), (Table 2).

The ultrasound examination of the calves affected by lung lesions, indicate that most of calves suffering from acute infection at a rate of (67%), while (33%) suffering from a chronic infection, and the type of lesion most frequent in acute cases were the lack of the irregular pleural membrane (94%), and comet-tail artifact (78%), followed by the alveologram (72%). While in chronic infections, the lesion appears as lung consolidation (33%), (Table 3). (Pictures 2, 3,4 vs. picture 1).

TABLE 1. Clinical assessment of the severity of lung affection in buffalo calves.

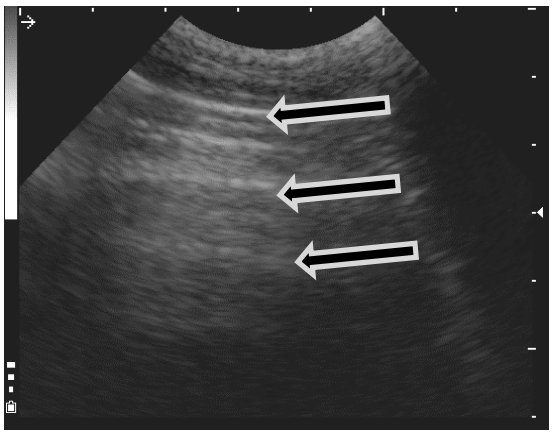
Severity of the Infection	Clinical assessment	No. (n=100)	Percentage
Mild	<4	16	16 %
Severe	≥4	84	84 %

TABLE 2. The score of disease severity at different ages.

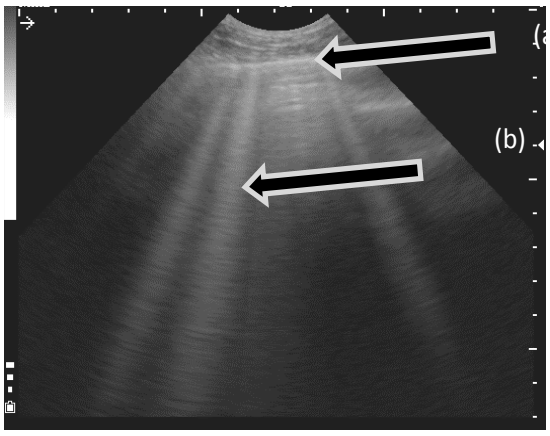
Severity score of the disease	Percentage		
	Ages/day		
	<90	≥90	Total
<4	2%	14%	16%
≥4	30%	54%	84%

TABLE 3. Determination of the severity of the infection and the type of lesion by ultrasound.

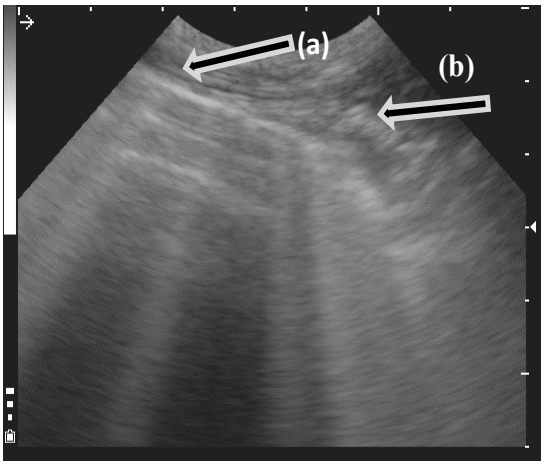
Severity of the Infection	Type of Lesion	Frequency	Percentage
Acute 67%	Irregular pleural membrane	94	94%
	Comet-tail artifact	78	78%
	Alveologram	72	72%
Chronic 33%	Lung consolidation	33	33%



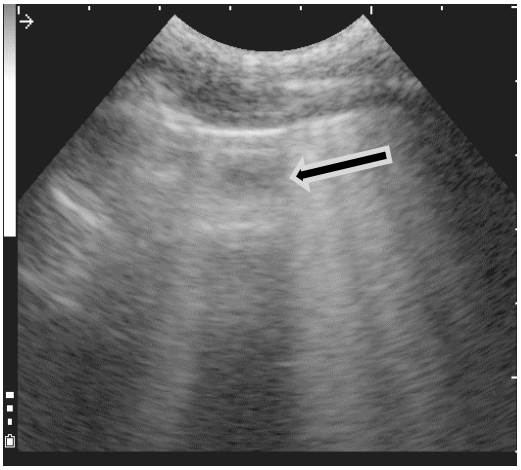
Picture 1. Normal Lung and pleural membrane in a healthy calf.



Picture 2. Lung of infected calf with presence of Comet-tail artifact (a) and Irregularity of pleural membrane(b)



Picture 3. A lung of infected calf, Irregularity of pleural membrane (a), Lung tissue consolidation(b).



Picture 4. Lung of infected calf, Presence of fluid in the lung tissue

Discussion

In the present study, the animals were suffered from severe infection, and this result agrees with the some researchers [5], the severe respiratory infection characterized by cough, nasal discharge, lacrimation and fever in the infected animals [17,18]. Calves are more susceptible to respiratory infections due to the lack of vaccinations for young ages, in addition to the incomplete immune system, as pathogens may be more severe on young animals [19].

The study, showed that most of the infections was at (≥90) days ages, this result agree with the result of Maier et al.[19]. The cause here may be due to the common bacterial infection, and/or viral infection such as (Bovine coronavirus, Bovine Respiratory Syncytial Virus, Bovine Viral Diarrhea Virus) [20]. The infection of bacterial pneumonia in calves occurs (60-180) days age, the infection may occur early in life (14 days of age) and gradually increases (35 to 42 days of the animal's age) [21].

In healthy calves, the ultrasound reflected back and forth at the border between the lung parenchyma and lung tissue, forming extensive echogenic structures in the form of reverberation artifact, where these formed what are called distinct echo lines of the healthy chest and these results agree with many investigators[22-24].

The images show characteristic pattern of well-ventilated lung tissue with a smooth visceral surface (reverberation artifact, reverberation pleural bundle), indicating that the normal lung tissue, while the comet-tail artifacts appear as very light radiating streaks which spreads like the spread of the sound and the evidence for this is the irregularity of the surface of the lung or the pleural membrane [25].

As for healthy pleural membrane, it appeared in the form of a small hyper echoic line, and due to the movement of the respiratory system, the visceral pleural membrane appeared sliding on the chest wall in the form of a hyperechoic line of the pleural membrane, and a reverberation artifact was observed beneath it on the ultrasound screen [26].

Through ultrasound examination, it was found that most of calves suffering from acute infection at a rate of (67%), this result agreed with the previous work [10] , which is characterized by irregular pleural membrane and the presence of the comet tail artifact and the alveologram, The irregular pleural membrane is due to a defect between the visceral and the parietal pleural membrane [10]. The comet tail artifact is a special form of reverberations that represent a series of convergent distances of unconnected echoes, which indicate a focal gathering of highly reflective materials in small quantities or even gas bubbles [27]. The alveologram result from accumulation of the fluids in the alveoli and appear as hypo echoic small area[24]. Through ultrasound examination, it was found that (33%) of the animals were suffering from chronic infection, this result agree with many authors [10,28], chronic infection is characterized by the appearance of lung consolidation upon ultrasound examination [28].

In calves suffering from bronchopneumonia, ultrasound examination shows small hypoechoic circular areas called alveologram (about 7 mm in diameter) on the surface of the lung where these represent superficial fluid of alveoli with the presence of the comet-tail artifact, where bronchopneumonia represents so-called consolidation and contains bifurcated alveoli with fluid inside. These sclerotic areas have an echoic appearance and are homogeneous with very distinct edges, these results are in agreement with Hussein et al. [29].

On ultrasound examination of some calves, the lung appeared in a fine granular hepatic structure, which indicates the presence of fibrinous pneumonia, and this result agrees with Rabeling et al. [26].

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Mohammed Tawfeeq Al-noaemy conducted the diagnosis and performed data analysis furthermore wrote the manuscript.

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الكشف عن آفات الرئة بتقنية الموجات فوق الصوتية في عجول الجاموس

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الخلفية العلمية: يعد مرض الجهاز التنفسي البقري عملية معقدة ومتعددة العوامل تسبب نفوق عجول الجاموس وقد يكون التشخيص المبكر صعباً بسبب غياب العلامات السريرية. التصوير بالموجات فوق الصوتية هو أداة غير جراحية تُستخدم بشكل شائع في تشخيص أمراض الصدر في عجول الجاموس والماشية.

الهدف: الهدف من هذه الدراسة هو الكشف السريري والفحص بالأمواج فوق الصوتية عن آفات الصدر وشدتها في عجول الجاموس.

الطرائق: شملت الدراسة فحص ١٣٠ حيوان من عجول الجاموس المحلي قسمت الى (١٠٠) عجل مصاب أظهرت اعراض تنفسية شملت السعال وتدمع العين و سيلان الانف والضعف العام و الحمى و (٣٠) عجل سليم سريريا عدو كمجموعة سيطرة، خلال المدة من تشرين الثاني ٢٠٢١ حتى نيسان ٢٠٢٢ ، تراوحت اعمارها بين (٢-٦) أشهر ومن مناطق مختلفة في مدينة الموصل.

النتائج: اظهرت نتائج الدراسة ان اغلب الاصابة كانت من النوع الشديد (٨٤ ٪) في حين ان (١٦٪) كانت تعاني من اصابة خفيفة وتبين ان اغلب الاصابة كانت في الاعمار ≤ ٩٠ يوم وكانت شدة الاصابة بتقييم (≤ ٤) وبنسبة (٥٤ ٪)، في حين ان اقل اصابة كانت في الاعمار>٩٠ يوم .ومن نتائج الفحص بالموجات فوق الصوتية آفات رئوية مختلفة ، كان أكثرها شيوعاً هو عدم انتظام غشاء الجنبة بنسبة (٩٤٪) وخادعة ذيل المذنب بنسبة (٧٨٪) و الحويصلات الظليلة بنسبة (٧٢٪) ، في حين كان تصلب الرئة الأقل بنسبة (٣٣٪).

الاستنتاجات: ان الفحص بالموجات فوق الصوتية ذو دقة عالية في تشخيص نوع الآفة وشدتها مقارنة بطريقة تسجيل العلامات السريرية، وأثبت وجود اصابات تنفسية في عجول الجاموس ذات الاعمار الصغيرة.

الكلمات المفتاحية: الامواج فوق الصوتية، التقييم السريري، آفات الرئة، عجول الجاموس.