CASE REPORT

PHYSICAL EXAMS AND SONOGRAPHY IN DIAGNOSIS OF SEVERE RESPIRATORY CONDITIONS IN CATTLE: A CASE REVIEW

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ABSTRACT

Auscultation and percussion are complementary and essential tools in the veterinary physical examination of the respiratory system, but they are ineffective in assessing the nature and extent of pulmonary pathology. In this clinical study, we have followed up on four cases of severe bovine respiratory disease. A general clinical examination was carried out, beginning with inspection, measurement of body temperature, and examination of the mucous membranes. Auscultation and percussion were the two key methods of physical examination. After that, the entire pulmonary field on both sides of the thorax underwent a sonographic examination. Results have shown that LUS combined with physical examination enabled a fairly accurate diagnosis and prognosis to be made in adult cows suffering from pulmonary disorders. The discussion of the results also provided an overview of some of the concepts involved in LUS and how they may relate to the findings of an ordinary clinical examination.

Keywords: Auscultation, percussion, lung sonography, pulmonary condition, cattle

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INTRODUCTION

Clinical examination of the respiratory system, whether by conventional means such as auscultation and percussion (Scott, 2013; Pardon et al., 2019; de Mattos et al., 2020) or by assessing a respiratory score (Buczinski et al., 2014; Cuevas-Gómez et al., 2021), is the main approach used to diagnose the bovine respiratory diseases and to establish criteria for treatment. However, these methods are limited in that they fail to detect subclinical respiratory conditions, courses of disease, and subsequent respiratory system damage. Lung ultrasography (LUS) has answered many diagnostic questions; it is a good method to screen and assess pleural and lung disorders. It can also reliably predict the viability of treated animals (Scott, 2013; Adams and Buczinski, 2016). Today, it is well known that LUS is better than radiography for detecting pleural effusion, pneumonia, and pulmonary edema (Marini et al., 2021). But LUS has its limitations, the main being the reflection of sound waves by the interface between the pleura and the pulmonary air (Marini et al., 2021). With less air in the lungs and alterations near the pleura, LUS gives a clear view of the subpleural abnormality (Tharwat and Oikawa, 2011). Likewise, consolidation processes and the comet tail artifact (CTA) phenomenon are other limiting factors that can lead to different diagnoses due to their various interpretations (Ali et al., 2014; El-Zahar et al., 2021). This study aims to highlight the importance of ultrasound in confirming a diagnosis of respiratory conditions when physical examination has been exhausted. In addition, this work will contribute to enriching the available ultrasound database on this topic.

MATERIAL AND METHODS

Physical examination

Four dairy cows were presented to the ruminant clinic of the Institute of Veterinary Sciences of Tiaret due to decreased appetite and respiratory signs. A routine clinical examination was done, except for the last case; it was shortened. The clinical examination began with inspection of the animal, measurement of body temperature, and examination of the mucous membranes. Auscultation and percussion then assessed the entire respiratory field, from the 4th to the 9th intercostal space (ICS), from the dorsal to the ventral part of the thorax, on both sides. Particular emphasis was given to auscultation and percussion with regard to exploration of the pulmonary system.

Sonographic examination

Both sides of the thorax were shaved. The skin was cleaned with alcohol, then ultrasound gel was applied. An ultrasound scan of the pulmonary field was then performed, based on standardized examination techniques (Flock 2004; Tharwat and Oikawa, 2011), from a dorsoventral plane holding the transducer parallel to the ribs with 3.5 MHz and 5 MHz convex transducer connected to a real-time B-mode portable ultrasound device (iScan 2 multi, Draminski S.A., Poland). The observed anomalies were the presence of CTA or B-line artifact (BLA), pleural fluid accumulation, pleural irregularity and thickening, consolidation, abscesses and emphysema.

Case 1

A 3-year-aged Holstein cow had been in inapetance for 8 days, with a body condition score (BCS) of 1.5. The cow presented with the head extended, a lethargic appearance, and respiratory signs (tachypnea and expiratory dyspnea, dilated nostrils and open-mouthed breathing with foaming (Figure 1). A putrid-smelling nasal discharge was noted. The rectal temperature recorded (37°C) was slightly below normal. The mucous membranes of the eyelids were slightly purplish, while those of the vulva were more so (Figure 2). Cardiac examination revealed tachycardia with a heart rate of 116 beats per minute. Pulmonary auscultation revealed fine crepitations (wet rales), and percussion of the caudodorsal lung on both sides showed dullness.

Figure 1 Foamy mouth with nasal discharge

Figure 2 Purplish appearance of ocular and vulvar mucosa

Sonography

The sonographic exam of the caudodorsal region of the left lung shows a bright line of pleura but no modified structure under it. The numerous CTAs born on the pleura and extending deep into the lung (Figure 3) suggest an interstitial syndrome. Lesions appeared more extensive in the right lung. The pleural line being thickened and the small hypoechoic areas on the surface of the lung represent "superficial liquid alveolograms" and subpleural consolidation, with more CTAs (Figure 4). Ultrasound images are mainly from the mid-dorsal and caudodorsal areas (between the 6th and 8th ICS).

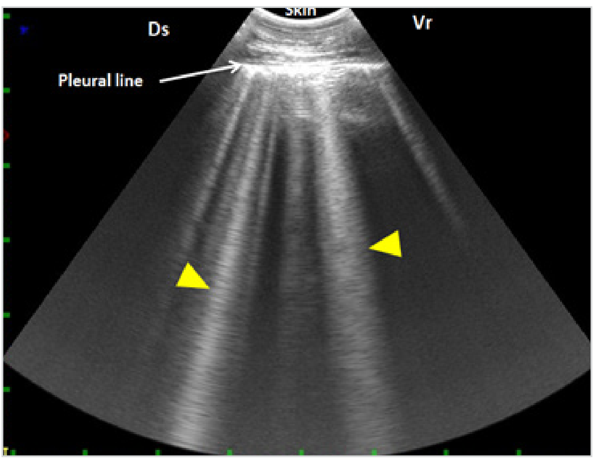

Figure 3 Sonogram of the left lung showing a bright line of thickened pleura, comet-tail artifacts fanning out from the lung-pleura interface and propagating to the image edge (arrowhead)

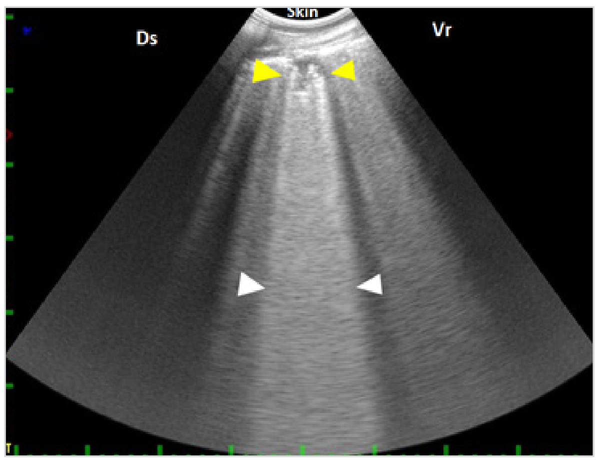

Figure 4 Sonogram of the right lung with small hypoechoic zones on the surface of the lungs represents superficial fluid alveolograms and bronchograms (yellow arrows) with multiple comet-tail artifacts (white arrows)

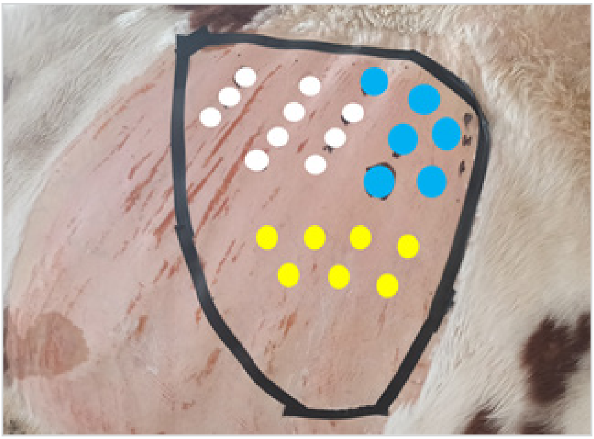

Figure 5 Sound types from right-side percussion: dull (blue), clear (white), hyper-resonant (yellow)

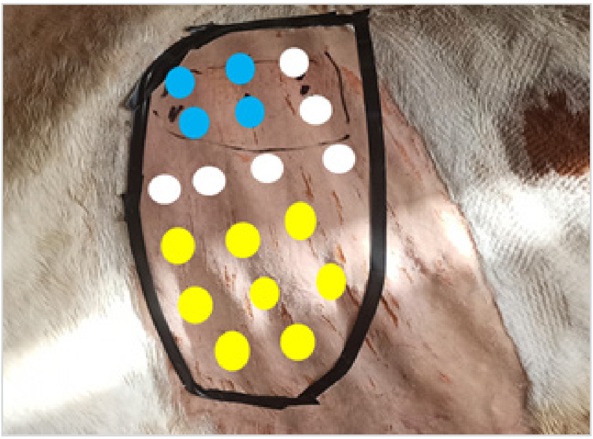

Figure 6 Left-side percussion sound type: limited dullness zone (blue), clear (white), hyper-resonant (yellow)

Sonographic findings, in addition to decreased resonance on percussion and wet rales on auscultation, point to pulmonary edema.

Case 2

It is about a 10-year-old crossbred Red Piebald cow with a poor BCS (1.5). The reason for the consultation was the cow's decreased appetite and coughing. Rectal temperature was normal (39.0 °C), as was the appearance of mucosa. The animal had an expiratory dyspnea, and auscultation revealed dry crackling rales over the entire right respiratory zone but on the left, rales were discrete. On percussion, the animal reacted to pain and coughed loudly. The dorsal and middle areas of the right lung showed dullness (Figure 5). On the

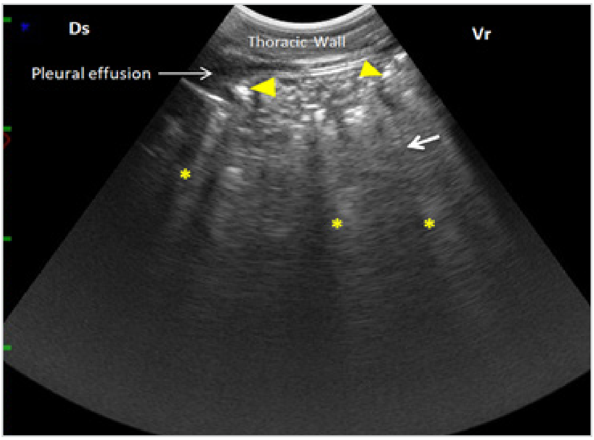

Figure 7 Lung consolidation: hyperechoic zones correspond to inclusions of air bronchograms (arrowheads), heterogeneous hyperechoic zone with comet-tail artifacts (asterisk), lower parynchial hepatization (white arrow) (left side)

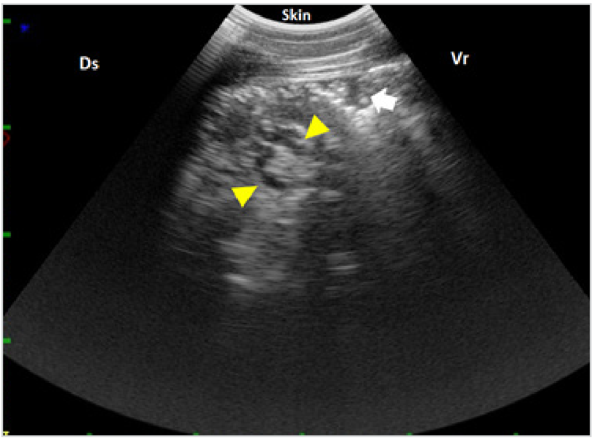

Figure 8 Extensive subpleural consolidation (white arrow); fluid bronchograms (yellow arrowheads) (right side)

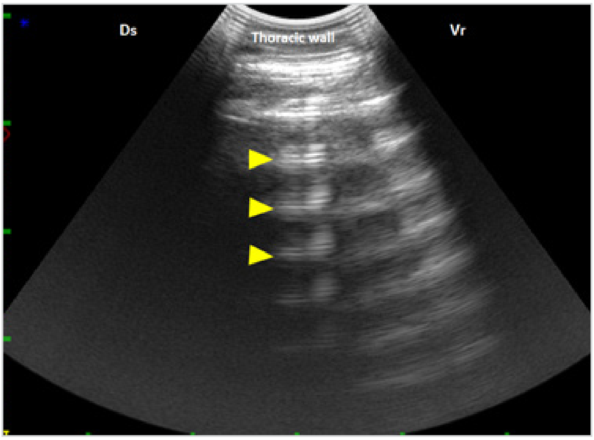

Figure 9 Emphysematous lung: multiple A-lines, rising from the pleura line and going deeper (arrowheads)

left lung, tympanum was dominant in the middle and lower parts. Dullness was limited to the craniodorsal region (Figure 6).

Sonography

Ultrasound examination of the left lung revealed signs of effusion between the pleural layers. The alveolograms appear as hyperechoic air inclusions, and parenchymal hepatization in the deep regions of the lung reveals a consolidation phenomenon (Figure 7). On the right side, examination of the area between the upper and middle thirds of the respiratory field at the level of the 7th ICS showed extensive consolidation, with anechoic liquid bronchograms (Figure 8). Beside, the multiple A-line artifacts observable, propagating from the subpleural lungs to distant parts of the image in Figure 9, are indicative of pulmonary emphysema.

Case 3

A 6-year-old crossbred cow presented with decreased appetite, recurrent coughing and bloating. The BCS of the cow was low (1.0). Rectal temperature was normal (38.9°C), as was the appearance of the mucous membranes. Heart rate and respiration were within normal limits. However, the respiratory type was markedly abdominal with mixed dyspnea, and a shortness of breath becoming more marked on the following days. Auscultation revealed dry crackles in the dorsal part of the right lung, but in the ventral part no sound was heard. In the dorsoventral parts of the left lung, bullous wheezes were heard over a

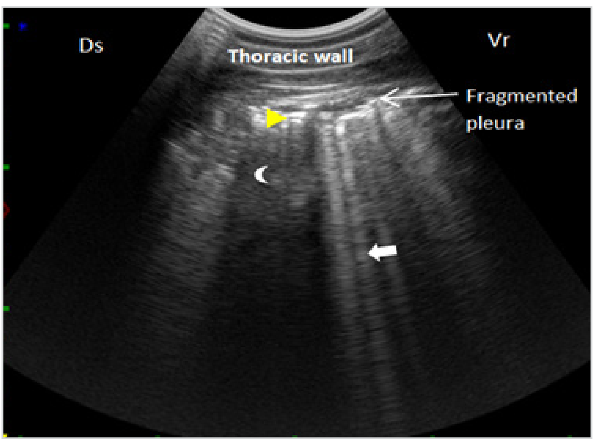

Figure 10 Fragmented pleura line with lung consolidation: hyperechoic zones correspond to inclusions of air bronchograms (arrowhead) with comet-tail artifacts (white arrow), lower parynchial hepatization (cressent)

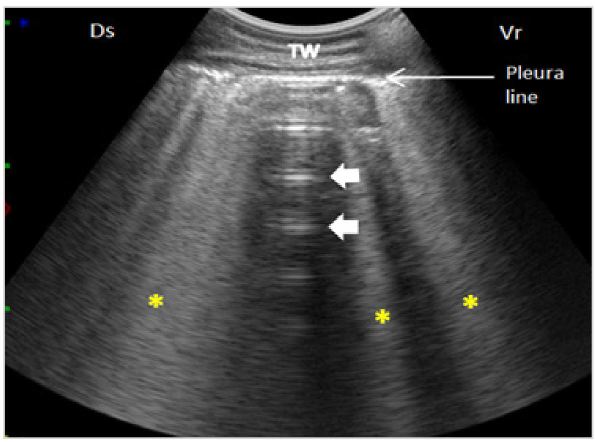

Figure 11 Emphysematous lung: multiple B-lines (asterisks) and A-lines (arrows), rising from the pleura line and going deeper on screen

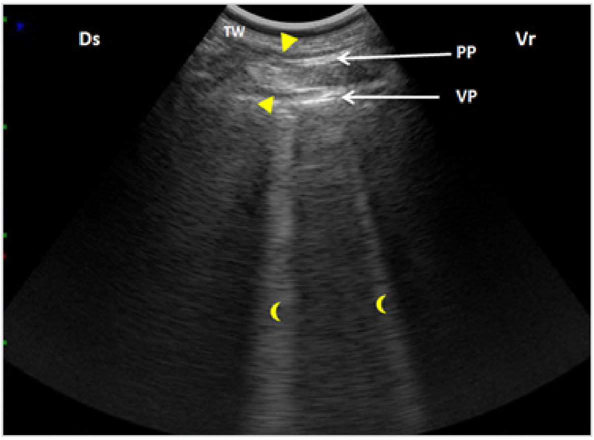

Figure 12 Thickened pleura (arrowhead) PP: parietal pleura, VP: visceral pleura. Comet-tail artifacts (crescent)

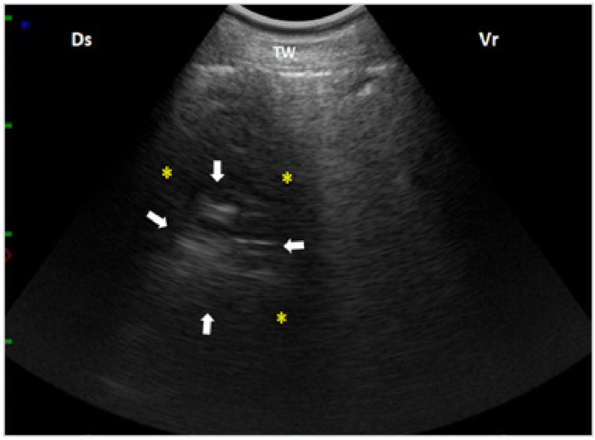

Figure 13 A large abscess pointed by white arrows, surrounded by anechoic liquid collection (asterisks) in the pulmonary parenchyma

wide area. Percussion had revealed no pathological sound in the dorsal areas of the right side, but the tympanum was clear in the cranio-ventral part of the thorax, with a characteristic ping resonance. On the left side, percussion revealed dullness in the dorsal area and a slight tympanum in the middle of the thorax.

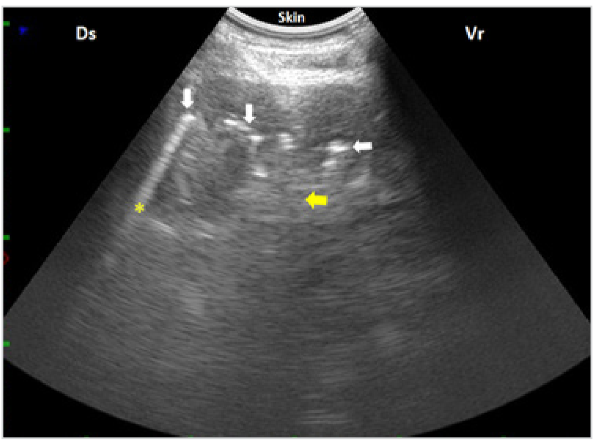

Figure 14 Echogenic structures, granular in shape (white arrows), comet-tail artifact (asterisk), and consolidation (yellow arrow), on the right side

Sonography

In Figure 10, the ultrasound image shows wide consolidation in the right caudodorsal region (8th ICS). The pleural line appears fragmented, with hyperechoic subpleural bronchograms accompanied by CTAs. The sonogram taken ventrally over the 6th and 7th ICS of the right lung (Figure 11) showed both B-lines and A-lines, propagating from the subpleural lungs to distant parts of the image with a sliding lung, clearly indicating pulmonary emphysema.

Case 4

A 5-year-old red Holstein cow presented with anorexia, coughing, and polypnea. The cow's BCS was poor (1.5) and clinical examination revealed a fever of 39.9°C, polypnea, and mixed dyspnea with head tense. Palpation of the external lymph nodes revealed significant hypertrophy of the prescapular and retropharyngeal.

Sonography

The left lung ultrasound showed pleural thickening with CTAs (Figure 12). Sononography had also revealed a large subpleural abscess with a hypoechoic center, surrounded by an anechoic collection (Figure 13). On the right side, we observed pleural thickening with subpleural hyperechoic granules, which may be tuberculosis (TB) micronodules (Figure 14). Besides, ultrasound of the liver also showed the existence of nodular structures.

DISCUSSION AND CONCLUSION

Acute respiratory distress syndrome (ARDS) is a condition observed in humans and animals. This syndrome is characterized by pulmonary hypertension responsible for intravascular neutrophil aggregation, diffuse alveolar lesions, permeability edema, and acute respiratory distress (López and Martinson, 2017; Soldari et al, 2019). In veterinary medicine, acute bovine pulmonary edema and emphysema (ABPEE) is a pathophysiological condition (Muhammad et al., 2010; Hananeh and Ismail, 2018) comparable to ARDS. This syndrome is better known as acute interstitial pneumonia (AIP), which is a sporadic and often fatal respiratory condition in feedlot cattle (Woolums, 2015; Haydock et al., 2022; Bortoluzzi et al., 2023). Interstitial pneumonia (IP) is characterized by the acute onset of severe respiratory distress and a combination of pulmonary lesions, including pulmonary edema and congestion, interstitial emphysema, and alveolar epithelialization (Arnold and Lehmkuhler, 2015). On ultrasound, the respiratory distress syndrome has compact, extensive B-lines, subpleural consolidations, and a thickened, irregular pleural line (Liu et al., 2023a). CTAs seen in AIP may result from unventilated areas created by small accumulations of exudate, blood, mucus, and edema (Tharwat and Oikawa, 2011). In interstitial pneumonia, CTAs or BLAs are long, well-defined, laser-like hyperechoic artifacts originating from the pleural line (Hussein et al., 2018; Manolescu et al., 2018). Soldati et al. (2019) have, therefore, described the ultrasound appearance of IP as a mixture of spared (normal) lungs and areas with diffuse fan-shaped vertical artifacts originating from the lung-wall interface, known as the “white lung pattern”. These reports are in perfect agreement with our observations in Figures 3 and 4. In view of our sonograms, IP appears to be primary and acute, given the absence of advanced and diffuse consolidation. In general, IP is characterized by diffuse lesions affecting all lung lobes; but, sometimes they are more pronounced in the caudodorsal part of the lung (Woolums 2015; López and Martinson, 2017), as we have seen. That said, primary or chronic bronchopneumonia (CBP) can lead to secondary AIP (Woolums, 2015; Haydock et al., 2022). In such cases, large areas of consolidation with alveolograms and bronchograms (Copetti et al., 2008; Carvallo and Stevenson, 2022) as well as the possible presence of abscesses (Panciera and Confer, 2010) will help to recognize the origin. Sometimes, bronchopneumonia with interstitial pneumonia is considered a variant of AIP rather than a separate disease (Haydock et al., 2023). However, there was no evidence of emphysema on clinical and ultrasound examination. Indeed, ultrasound cannot always distinguish edema from emphysema because of their common features, notably the presence of BLAs or CTAs in both cases (Buczinski et al., 2014; El-Zahar et al., 2021). Furthermore, diffuse BLA can be associated not only with edema but also with lung hemorrhage (Woolums, 2015).

On the other hand, AIP primarily affects the left side of the heart, leading to left heart failure (Hananeh and Ismail, 2018); that can lead to confusion with primary left congestive heart failure or pericarditis. What is more, differentiating cardiogenic or hydrostatic pulmonary edema from AIP is a real challenge, particularly in the early stages of the disease (Soldati et al., 2019). In cardiogenic pulmonary edema (CPE), the ultrasound image shows no intermittent white areas with spared zones; also, alveolar collapse and air bronchograms are absent. But in late-onset CPE, after alveolar flooding has occurred, the ultrasound image will be confused with that of early-onset AIP, often showing spared areas (Soldati et al., 2019). In addition, diffuse interstitial diseases may be associated with CPE, adding further uncertainty to the diagnosis (Soldati et al., 2019). In the case of inhalation pneumonia, the ultrasound will show a pleura separated by a large anechoic zone containing multiple hyperechoic dots due to abscesses or pyothorax (Scott, 2012). Finally, Table 1 presents the ultrasound signs that guide differential diagnosis with AIP.

Bronchopneumonia describes both suppurative and fibrinous consolidation of the lungs (López and Martinson, 2017). In chronic pneumonia, diffuse alveolar damage defines the fibrosing stage with alveolar collapse, basement membrane fusion, and fibroblast proliferation (Carvallo and Stevenson, 2022). Consolidation often affects the posterior fields, particularly the bases, with an evidence of static or dynamic bronchograms (Copetti et al., 2008). In our case study, consolidation was extensive, with air bronchograms (Figure 7) suggesting complete lobar consolidation. Pulmonary consolidation in animals was reported to occur, most commonly, cranioventrally with bilateral distribution (López and Martinson, 2017). This fact is explained by inhalation as a possible cause of the pulmonary infectious pathway (Bayoumi et al., 2022). However, Tharwat and Al-Sobayil (2017) speak rather of a predominantly caudodorsal consolidation in the right lung, suggesting a hematogenous infection. So, several authors have agreed that consolidation of the entire lung lobe is associated with bacterial BP (Ollivett and Buczinski, 2016; Hoffelner et al., 2023). On LUS, consolidation shows a relatively hypoechoic heterogeneous echotexture (Berman et al., 2019), which describes the filling of bronchioles and alveoli with fluid, pus, blood, or cells (Grune, 2020). Consolidations due to pneumonia may also contain multiple lens-sized hyperechoic spots due to air trapped in the small airways, with associated CTAs (Nazerian et al., 2015). Bronchograms can accompany consolidations, appearing hyperechoic when aerated and rather as hypoechoic structures on lung ultrasound if fluid-filled (Grune, 2020). When structures are echogenic, consolidation appears isoechoic with the liver; this is known as pulmonary "hepatization" (Copetti et al., 2008).

The descriptions of consolidation processes given above by Nazerian et al. (2015), Grune (2020), and Copetti et al. (2008) correspond perfectly to what we have observed in Figures 7 and 8. In cases of CBP, consolidation has a more lumpy distribution; there is more obvious purulent bronchitis, bronchiectasis, and abscess formation (Panciera and Confer, 2010; Scott, 2013). In both animals and humans, consolidation is due to densification of lung tissue and leads to complete deaeration (Laursen et al., 2021); a wide consolidation is, therefore, linked to poor outcomes (Berman et al., 2019). However, early administration of antibiotics and anti-inflammatory drugs may reduce subsequent pathological effects (Fiore et al., 2022). In addition, physical examination revealed emphysema due to decreased intensity of breath sounds with tympany, as well as expiratory dyspnea seen during inspection. In Figure 9, emphysema appears as "multiple A-lines" due to the increased amount of subpleural air, as illustrated by Manolescu et al. (2018). In CBP, alveolar or interstitial emphysema occurs as a result of airflow obstruction and air penetration into deeply damaged lung parenchyma (Flock, 2004; López and Martinson, 2017). These serious alterations of the respiratory system lead to a severe lack of oxygen for the cow's metabolism, particularly in hot summer weather, thus resulting in hyperventilation, and mouth breathing. Lastly, CBP sonographic diagnosis is difficult to differentiate from other chronic lung diseases (Table 1), particularly when lesions are multiple and extensive. The consolidation phenomenon itself can be a factor of diagnostic uncertainty, as it may be due to infection, inflammation, granuloma formation, or neoplasia (Ali et al., 2014).

In cattle, primary pleural disorders are rare, and pleuropneumonia often results from subsequent bronchopneumonia (Braun et al 1997 ; Robcis et al., 2023). Clinically, the Case 3 presented with dyspnea, but no pleural friction rub on auscultation. However, ultrasound had shown a fragmented pleural line with subpleural consolidations, air bronchograms and CTAs (Figure 10), as seen by Kreuter and Mathis (2014) in pleurisy. But, a marked irregularity of the pleural line, with a thickened, fragmented, and/or blurred appearance, may also suggest an aggressive or advanced stage of fibrotic disease (Rea et al., 2021). Also, pulmonary emphysema was diagnosed based on clinical examination as increased resonance of lung field upon percussion with silent lung sign in auscultion; as well, the mixed dyspnea confirmed it. By sonography, pulmonary emphysema was characterized by numerous B-lines and A-lines (Figure 11), closely situated echo bands starting at the surface of the lung and running perpendicular to the pleura, which is in accordance with Manolescu et al. (2018) and Khalphallah et al. (2022) reports. Lung sliding, the movement between the visceral and parietal pleura during spontaneous respiration (Chen and Zhang, 2015), was present in this case, which helped to confirm the diagnosis of emphysema. The absence of this sign would have suggested the possibility of pneumothorax (Husain et al., 2012), in particular with the ping resonance detected on percussion of the ventral parts of the thorax.

Pulmonary tuberculosis may be revealed on ultrasound by consolidation, subpleural nodules, pleural thickening, fibrosis, and miliary lesions (Cocco et al., 2022). In their chronic phase, TB granulomas are necrotic and mineralized; they are irregularly shaped, multicentric, with prominent caseous necrosis and a thick capsule (Hunter et al., 2023). In our case, ultrasound showed thickening of pleural line (Figure 12). In addition, systemic tuberculosis infection may involve abscesses and chronic sinus formation, which are often secondary to pulmonary, pleural, or mediastinal tuberculous abscesses; they appear on the ultrasound image as hypoechoic areas with varying degrees of internal heterogeneity (Rea et al., 2021). In the present case, the abscess appears rather heterogeneous and hypoechoic in the center, surrounded by an anechogenic band; it was subpleural, which permitted its observation (Figure 13). When the pleura is in good condition and an abscess is located deep in the lung, it cannot be detected by ultrasound (Flock, 2004). As well, in pulmonary TB, the most common parenchymal findings on LUS are subpleural nodules and pulmonary consolidations (Rea et al., 2021), as shown in Figure 14. In addition to pleural and pulmonary abnormalities, LUS also revealed liver lesions. In endemic regions, TB diagnosis often relies on the detection of extra-pulmonary lesions through ultrasound (Hunter et al., 2016). In addition, the presence of fever and lymph node reactions are further signs in favor of the diagnosis of disease. Tuberculosis is, therefore, a neglected disease in our country, and screening is not automatic. This implies great vigilance on the clinician's part in examining cattle suspected of having tuberculosis, given the risk of contamination through direct contact or inhalation (Monde et al., 2023; Toribio et al., 2023).

In terms of differential diagnosis (Table 1), primary thoracic neoplasms should be considered, despite their rarity in adult cattle, when respiratory clinical signs and cachexia are concomitant (Robcis et al., 2023). Thus, adenocarcinoma is the most frequently reported lung neoplasm in cattle (Neto et al., 2019). LUS constitutes an excellent approach to the differential diagnosis of infectious lung diseases, as it can highlight specific lesions (Giannelli et al., 2022).

Table 1 Sonographic signs of the diagnosed respiratory conditions, with respective differential diagnoses, compared with bibliographic reports

Suspected disease and sonographic findings	Bibliographic reports	Conditions involving a differential diagnosis and sonographic signs	
Acute interstitial pneumonia : - Thickened pleura - Subplaural consolidation - Fluid alveolograms - Numerous CTAs (white lung)	- Coalescent B-lines and white lung - Irregular pleural line and reduced pleural sliding - Consolidations, subpleural nodules, or micronodules (Soldati and Demi, 2017) - Focal, patchy, or diffuse fan-shaped vertical comet-tail artifacts (interstitial syndrome) (Soldati et al., 2019) - Superficial fluid alveolograms (Tharwat and Oikawa, 2011).	Cardiogenic pulmonary edema	- No consolidations, no pleural nodules or pleural irregularities (Soldati and Demi, 2017) - Uniform distribution of comet-tail artifacts - Normal lung sliding - Homogenous pleural effusion (Grune et al., 2020)
		Pulmonary hemorrhages	- Diffuse B-line artifacts (Woolums, 2015) - Pleural effusion - Fibrin deposition sign (Liu et al., 2023b)
		Emphysema	- Diffuse comet-taila rtifacts (Buczinski et al., 2014; El-Zahar et al., 2021) - Multiple A-lines due to the increase in the amount of subpleural air (Manolescu et al., 2018)
		Inhalation pneumonia	-Separate, anechoic subpleural zone - Multiple hyperechoic patches (abscess/pyothorax) (Scott, 2012)
		Embolic pneumonia	- Consolidation - Hyperechoic nodules (Kim et al., 2023)

Bronchopneumonia and pleuropneumonia - Pleura effusion - Fragmented pleura - Cranioventralbilateral consolidation - Alveolograms (hyperechoic) - Bronchograms (hypoechoic) - Hepatization - Multiple B-lines (emphysema sign).	- Cranioventral bilateral consolidation (López and Martinson, 2017; Bayoumi et al., 2022) - Hypoechoic heterogeneous echotexture (Berman et al., 2019) - Lens-sized hyperechoic spots with B-lines artifacts (Nazerian et al., 2015) - Air bronchograms and hepatization (Copetti et al., 2008) - Abscess (Panciera and Confer, 2010)	Fibrinous pleurisy / fibrinous bronchopneumonia (shipping fever)	- Interruptedvisceral pleura - Pleural effusion with accumulation of fibrin: hyperechoic fibrin matrix and anechoic background (Scott and Sargison, 2012; Hussein et al., 2018) - Pleural and lung abscesses: uniform hypoechoic to anechoic area containing many hyperechoic spots representing gas echoes within the abscess (Scott and Sargison, 2012) - Absence of lung sliding with pleural adhesions (Husain et al., 2012)
		Millarytuberculosis	- Consolidation, subpleural nodules, fibrosis (Cocco et al., 2022)
		Lung fibrosis	- Numerous B-lines (Manolescu et al., 2018) - Consolidation with subpleural hypoechoic nodules (Yan et al., 2021)
		Chronic Interstitial Pneumonia	- Cranioventral consolidation (Doster, 2010) - Comparable features to chronic bronchopneumonia (Carvallo and Stevenson, 2022; Haydock et al., 2022)
		Pneumothorax	- Numerous B-lines - Absence of lung sliding (Husain et al., 2012; Chen and Zhang, 2015)

Tuberculosis : - Thickened pleura. - Consolidation. - Subpleural micronodules. - Subpleuralabscess.	- Pleural thickening, consolidation, subpleural nodules, fibrosis (Cocco et al., 2022). - Abscesses and chronic sinus with varying degrees of internal heterogeneity (Rea et al., 2021). - Associated extra-pulmonary lesions (Hunter et al., 2016).	Lung fibrosis	- Thickened and irregularly fragmented pleural line (Manolescu et al., 2018; Yan et al., 2021) - Consolidation with subpleural hypoechoic nodules (Yan et al., 2021) - Numerous B-lines (bronchiectasis, fibrotic alveolar syndrome) (Manolescu et al., 2018; Yan et al., 2021) - Eventual absence of lung sliding (Husain et al., 2012)
		Subacute and chronic forms of AIP	- Immature granulation tissue - Mature fibrosis (Haydock et al., 2022)
		Primarypulmona-ryneoplasms	- Lung metastasis appearing as large hypoechoic area bordered by a hyperechoic line (Scott and Sargison, 2012) - Heterogeneous parynchyma with hypoechoic areas of variable size - Homogeneous nodules, uncapsulated and hypoechoic - No B-line artifacts (Neto et al., 2019)

In summary, all the cases monitored in this clinical study presented with anorexia, poor body score, and respiratory conditions. Only one case had a fever, and this was a case of tuberculosis. In non-infectious or chronic lung diseases, body temperature generally remains within the normal range. These clinical and sonographic examinations indicate that auscultation is an essential tool in physical examination for the diagnosis of respiratory diseases. Percussion is another mean of examining the lung field that holds equal importance. Percussion offers many advantages, as it can confirm the results of auscultation. In addition to revealing chest pain, percussion provides precise indications of fluid or air infiltration in the lung parenchyma and thorax, as well as changes in the lung parynchyma. In this study, LUS had confirmed some of the physical examination findings and gave us a clear indication of the extent of the lung lesions, which enabled us to make accurate diagnoses and prognoses. Finally, this clinical study shows that examination of the respiratory tract in cattle using a portable ultrasound scanner is a practical and effective method that can be integrated into the routine of the bovine clinic.

In clinical practice, both percussion and auscultation have certain limitations when it comes to identifying the type of lesion, stage and extent of respiratory condition. The limitations of LUS are related to the non-perception of lesions under a healthy pleura on the one hand and to B-lines, which can indicate several types of pathological phenomena, on the other. Furthermore, LUS is a method that depends on the operator’s experience, and results may therefore be biased.

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CONFLICT OF INTEREST

The author declares that he has no conflict of interest.

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FIZIKALNI PREGLED I SONOGRAFIJA U DIJAGNOSTICIRANJU TEŠKIH RESPIRATORNIH STANJA KOD STOKE: PRIKAZ SLUČAJA

SAŽETAK

Auskultacija i perkusija predstavljaju komplementarne i osnovne metode kod veterinarskog fizikalnog pregleda respiratornog sistema, ali nisu učinkovite u procjeni prirode i opsega plućne patologije. U našem kliničkom istraživanju smo prikazali četiri slučaja teške bovine respiratorne bolesti. Obavljen je opći klinički pregled počevši od inspekcije, mjerenja tjelesne temperature i pregleda mukoznih membrana. Ključne metode fizikalnog pregleda su bile auskultacija i perkusija. Nakon toga je izvršen ultrazvučni pregled cijelog plućnog polja s obje strane grudnog koša. Rezultati su pokazali da je sonografija pluća (LUS) zajedno sa fizikalnim pregledom omogućila postavljanje dosta precizne dijagnoze i prognoze kod odraslih krava sa plućnim oboljenjima. U diskusiji smo pružili pregled određenih koncepata sonografije pluća i njihov odnos prema običnom kliničkom pregledu.

Ključne riječi: Auskultacija, perkusija, plućna bolest, sonografija pluća, stoka