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Diagnosis of caprine pneumonia: impact of vitamin D deficiency and other risk factors in its incidence

Yasmin H. Bayoumi [1], Eslam F. Eisa[2], Nader M. Sobhy [3], Nora El-Seddawy [4], N Noura E. Attia[1,*]

[1] *Department of Animal Medicine (Internal Medicine), Faculty of Veterinary Medicine, Zagazig University, Egypt*

[2] *Department of Surgery, Anesthesiology and Radiology, Faculty of Veterinary Medicine, Zagazig University, Egypt*

[3] *Department of Animal Medicine (Infectious Diseases), Faculty of Veterinary Medicine, Zagazig University, Egypt*

[4] *Department of Pathology, Faculty of Veterinary Medicine, Zagazig University, Egypt.*

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ABSTRACT

The objectives of this study were to apply different methods for diagnosis of caprine pneumonia and to study the correlation between vitamin D concentration and the immunoglobulin's (IgG, IgM, IgA) in goats up to one year in response to pneumonia. From October 2018 to February 2021, a total of 107 baladi goats were examined; 20 apparently healthy goats used as control group (group I, n=20) and 87 pneumonic Baladi goats were diagnosed on the basis of clinical symptoms, ultrasonographic, chest x-ray findings. Serum vitamin D, IgG, IgM and IgA levels were also measured. Pneumonic goats (group II, n= 87) were subdivided into two groups according to their vitamin D levels; pneumonic goat with normal vitamin D level (groupII a, n= 38) and pneumonic goat with decreased vitamin D levels (groupIIb, n= 49). Pneumonic goats were presented with fever, dullness, tachypnoea, bilateral mucoid or mucopurulent/purulent nasal discharge, cough, dyspnea and abnormal lung auscultation. Ultrasonography, the pneumonic consolidation exhibits a liver like echotexture. Abnormality in the chest x-ray revealed increased opacity that may be more gray or white and cotton wool like appearance. Pneumonic goats with reduced vitamin D concentration (group IIb) also revealed significantly lower IgG and IgM concentrations in comparison to both group I and group II a. Vitamin D was positively correlated with IgG. Histopathologically, the pneumonic lesions include interstitial pneumonia, acute suppurative bronchopneumonia and acute fibrinous bronchopneumonia. On the basis of all findings, decrease vitamin D level may be important predisposing factors for occurrence of pneumonia in goats up to1years.

1. INTRODUCTION

Respiratory diseases are the most frequent disease complex affects goats. Most respiratory diseases are represented as an inflammatory response of the lung known as pneumonia. Pneumonia complexity can be illustrated through interactions between the host (physiological and immunological factors), the etiology (virus, bacteria, mycoplasma, parasite, etc.), and the environmental factors like temperature, humidity, etc. (Attoh-Kotoku et al., 2018). Studying the associated risk factors with pneumonia is a central part of disease prevention and prognosis of infected cases. Furthermore, accurate clinical diagnosis of pneumonia should include physical examination, laboratory findings and different imaging techniques (Mukasa-Mugerwa et al., 2000). The correlation between low vitamin D levels and high risks of acquiring pneumonia in humans was confirmed (Oktaria et al., 2021). Moreover, supplementation with vitamin D could prevent and accelerate pneumonia treatment by improving immune function and reducing inflammation (Grant et al., 2020). Attia et al. (2016) suggested a decrease in vitamin D has a role in pneumonia occurrence among calves due to a direct effect on animal immunity. The adaptive immune system can recognize, destroy, and clear foreign antigens through immunoglobulins (IgG, IgM, and IgA) that are glycoproteins produced by B-cells and plasma cells(Marshall et al. 2018). The role of vitamin D deficiency in pneumonia incidence and its correlation with immunoglobulins levels in pneumonic goats were not studied before. Vitamin D regulates immunity, innate and adaptive, through vitamin D receptors (VDRs) that are present in most of the immune system cells. Deficiency in vitamin D leads to a reduction in VDRs levels in vivo and subsequent denaturation, cornification, and proliferation of respiratory tract mucous membrane epithelia and damaging their clearance function with the accumulation of non-neutralized proinflammatory media. Consequently, the inflammatory reactions could not be controlled, leading to injury in pulmonary tissues and blocking in gas exchange (Williams et al., 2008). This study represents a detailed diagnosis of pneumonia in goats, associated risk factors, and find out the correlation between vitamin D concentration and

Correspondence to: noura_abobaker@yahoo.com

the emitted immunoglobulins (IgG, IgM, and IgA) as a response to pneumonia.

2. MATERIAL AND METHODS

2.1. Animals

A total of 107 Baladi goats (two months - one year) were investigated over three years (January 2018 - April 2021). Goats were divided into two groups (Group I and Group II). Group I included20 apparently healthy goats as a control, and group II included87 pneumonic goats that were admitted to the Veterinary Hospital, Zagazig University, Egypt. Pneumonic goats were subdivided into two sub-groups according to their vitamin D levels, Pneumonic goats with normal vitamin D levels (group II a, n= 38) and pneumonic goats with low vitamin D levels (group II b, n= 49).Goats were enrolled in this study upon four criteria: (1) compatible respiratory symptoms, (2) goats up to one year, (3) a positive finding of both ultrasound and chest x-ray, (4) duration of symptoms did not exceed one week. A detailed case history including age, sex, onset and duration of symptoms, season, rearing climate, hygienic practices, and husbandry were collected from owners. In this study, poor husbandry means imbalanced ration, contaminated or insufficient water, overcrowding, poor ventilation with high humidity, and poor sanitation. Upon admission, all animals were subjected to clinical examination according to Jackson and Cockcroft (2002)

2.2. Biochemical examination

Blood samples were collected from all goats during the first admission and sera were separated for biochemical analysis. Serum total protein and albumin were estimated by standard procedures using diagnostic commercial kits,(Egyptian company for biotechnology, Cairo, Egypt).Serum immunoglobulins (IgG, IgM, and IgA) were measured using sandwich ELISA kits with a technique modified by Bianchi et al. (1995).Serum vitamin D levels were measured by commercial ELISA kits (Beijing Savant Biotechnology Co., China).

2.3. Ultrasonographic and Radiographic examination

Lungs of all animals were scanned using a 7 MHz transducer (Sonoscape A5V, China), after animal preparation according to the method described by Tharwat and Al-Sobayil (2017).Radiographs were performed using an X-ray machine (Pox-300 BT, Toshiba, Rotanode TM, Japan) from both left and right lateral views without tranquilizer as recommended by Olatunji-Akioye et al. (2020). The exposure factors ranged from45-50 kV and 50 mA-S with 70- 75 cm as focal film distance (FFD). The films were manually processed in a darkroom.

2.4. Histopathological examination

Lungs of 14 dead and/or slaughtered goats (group IIa=4 and group IIb=10) were examined for gross abnormalities and small tissue specimens were collected in 10% neutral buffered formalin solution for fixation. Specimens were dehydrated in ascending gradual alcohol (70-100%), cleared in xylene, embedded in paraffin, sliced (five microns), and stained with hematoxylin and eosin stain according to Bancroft et al. (2013) then examined microscopically

2.5. Statistical analysis

Vital signs (respiratory, heart rates, and temperatures) and biochemical parameters were analyzed by one-way analysis of variance (ANOVA) using IBM SPSS statistics software (version 25).The results were demonstrated as means ± SE and were considered statistically significant when $p<0.05$. Pearson correlation coefficient and significance of the correlation between measured parameters were evaluated according to Feldman et al. (2003)

3. RESULTS

3.1. Clinical examination

Pneumonia in group II a and group II b was increased mostly in younger kids (median age 6.8±0.54 and 5.8±0.55 m) and among females (63.2% and 57.1%) during the winter season (65.8% and67.4%), with insufficient sun exposure(23.7%and 79.6%) and poor husbandry (55.2% and 79.6%)(Table 1). The clinical signs in pneumonic goats were recorded in (Table 2). Duration of symptoms was 4.8± 0.5 and 5.1± 0.4 days in group IIa and group IIb, respectively. Pneumonic goats suffered from inappetence to anorexia, dullness, fever, tachypnoea, tachycardia, congested or cyanosed mucous membrane, bilateral nasal discharge (mucoid, mucopurulent/purulent), cough, dyspnea, mouth breathing, and harried painful respiration. The recorded symptoms were more severe in pneumonic goats with low vitamin D levels than those with normal levels. Percussion of the thorax revealed either unilateral or bilateral volume reduction. Auscultation of the lung revealed a combination of moderate to severe exaggerated vesicular sound, crackle sound, moist and dry rales, wheezes, pleuritic friction sounds, and in some cases heart sound heard on the lung area.

3.2. Biochemical Findings

There was no significant alteration between vitamin D levels in group IIa (76.33 ± 3.756 pg/ml) and control group I (86.67 ± 4.055 pg/ml). However, a significant decrease ($p < 0.05$) was detected between group IIb (36.33 ± 2.028) in comparison to group I and group IIa (Table3).The mean values of serum total proteins and albumin were significantly lower in group IIb than in the control group and serum globulin was increased significantly in group II a in comparison to groups I and IIb. Serum IgG was increased significantly in group II a in comparison to group I (2 folds) and group IIb (3 folds). Serum IgM was increased significantly in group IIa than group IIb while there was no significance in serum IgA was between the three groups. Vitamin D was positively correlated with serum total protein (r=823, P=0.002) and IgG (r=0.651, P=0.035). A non-significant positive correlation was recorded between vitamin D and IgM (r=0.578, P=0.103), while no correlation was recorded between vitamin D and IgA. Serum globulin was positively correlated with IgG (r=0.709, P=0.032) (Table 4).

3.3. Ultrasonographic Findings

Ultrasonographically, consolidation of pneumonic lungs appeared as a homogenous or heterogeneous hypoechoic to echoic structure with absences of reverberation artifacts (Fig.1A). Pulmonary abscess appeared more echogenic (group IIa=1 and group IIb=9) (Fig.1B). Both normal and consolidated parts of the lungs were also visualized in pneumonic goats (Fig.1C &D); normal parts characterized by the uppermost hyperechoic linear image with numerous reverberation artifacts running regularly and parallel below this line in, the broad, smooth, hyperechoic line between the surface of the lungs and the musculature of the thoracic wall moving synchronously with respiration.

3.4. Radiographic pattern in normal and pneumonic goats

Normal goat radiography of chest revealed normal trachea that appeared as a clear radiolucent air-filled structure from the neck to the cranial to mediastinum at which bifurcates into right and left bronchi dorsal to the base of the heart. Lung radio density varied according to the lung inflation during radiography as highest in expiration than in inspiration processes. The pleural cavity appeared as space between the lung and thoracic wall and the pleura are very thin and not usually seen in normal radiograph (Fig. 2A). Radiograph revealed high opacity in pneumonic goats. Opacity was a region of high gray or white densities and appeared as a cotton wool-like appearance. Opacity was mostly localized cranioventrally (Fig.2B-F). Ultrasonographic and radiographic examinations revealed 38 and 49pneumonic lesions either unilateral (group IIa =24/38 and group IIb =14/49) or bilateral (group IIa =14/38 and group IIb =35/49), respectively

3.5. Postmortem and histopathological findings

Gross examination of lungs among 14 dead or slaughtered cases (group IIa =3and group IIb =11) revealed nine hard, congested, consolidated, or hepatized parts (group IIa =2 and group IIb =7) (Fig.3A&B) and five pulmonary abscess (group IIa =1 and group IIb =4) (Fig.3C&D). Histopathologically, out of 14 cases, three (group IIa =2and group IIb =1), five (group IIa =1and group IIb =4), and six (group IIb) revealed interstitial pneumonia, acute suppurative bronchopneumonia, and acute fibrinous bronchopneumonia, respectively. Lesions of broncho-interstitial pneumonia were represented by extensive exudation of the bronchial tree (lumen and wall) and alveoli by serous, fibrinous, and suppurative exudate. Some alveoli showed detachment of alveolar macrophages (pneumocyte type II) inside its lumen which phagocytized dead neutrophils with dilation of inter alveolar capillaries and neutrophils infiltration (Fig.4A-C). Sometimes suppurative caseated masses were scattered within pulmonary tissue with clusters of basophilic bacterial colonies were disseminated within caseous necrosis (Fig.4D). The pleura and pulmonary septa showed extensive thickening by fibrinous and suppurative exudate (Fig.4E), Some pulmonary blood vessels showed recent thrombosis that attached to the wall of blood vessels consisting of faint eosinophilic fibrin thread, RBCs, and neutrophils (Fig.4F)

Table (1): Factors affecting the occurrence of pneumonia in goats under study

Variables		Control group	Pneumonic goats	
			Normal vitamin D level	Reduced vitamin D level
Median age (months)		6.8± 0.55	6.8±0.54	5.8±0.55
Sex	Male	50% (10/20)	36.8% (14/38)	42.9% (21/49)
	Female	50% (10/20)	63.2% (24/38)	57.1% (28/49)
Season	Winter	30% (6/20)	65.8% (25/38)	67.4% (33/49)
	Spring	20% (4/20)	13.2% (5/38)	8.2% (4/49)
	Summer	30% (6/20)	7.9% (3/38)	12.2% (6/49)
	Fall	20% (4/20)	13.2% (5/38)	12.2% (6/49)
Sun exposure	Good	100% (20/20)	76.3% (29/38)	20.4% (10/49)
	Insufficient	0% (0/20)	23.7% (9/38)	79.6% (39/49)
Animal husbandry	Good	100% (20/20)	44.7% (17/38)	20.4 % (10/49)
	poor	0% (0/20)	55.3% (21/38)	79.6% (39/49)

Table (2): Clinical observations in healthy and pneumonic goats

Items	Control % (N/T)	Pneumonic goats %(N/T)	
		Normal vitamin D level	Reduced vitamin D level
Duration of symptoms (days)	----	4.8± 0.5	5.1± 0.4
Body temperature °C:	39.47 ± 0.088^{b}	40.37 ± 0.176^{a}	40.47 ± 0.203^{a}
Respiratory rate/minute:	23.67 ± 0.882^{b}	34.00 ± 1.528^{a}	37.00 ± 2.082^{a}
Heart rate/minute:	82.00 ± 1.732^{b}	102.3 ± 3.930^{a}	109.0 ± 4.583^{a}
Conjunctival mucous membrane:			
Bright rose red	100% (20/20)	13.2 (5/38)	2% (1/49)
Congested	0 % (0/20)	81.6 (31/38)	89.8% (44/49)
Cyanosed	0 % (0/20)	5.2 (2/38)	8.2% (4/49)
Inappetence to anorexia	0% (0/20)	89.5 (34/38)	100% (49/49)
Dullness and depression	0% (0/20)	78.9% (30/38)	89.8% (44/49)
Nasal discharge	0% (0/20)	84.2% (32/38)	91.8% (45/49)
Dyspnoea	0% (0/20)	71% (27/38)	81.6% (40/49)
Cough	0% (0/20)	78.9% (30/38)	85.7% (42/49)
Harried painful respiration	0% (0/20)	44.7% (17/38)	55.1% (27/49)
Abnormal Lung percussion	0% (0/20)	84.2% (32/38)	85.7% (42/49)
Abnormal Lung auscultation	0% (0/20)	100% (38/38)	100% (49/49)
Ultrasound abnormalities in lung	0% (0/20)	100% (38/38)	100% (49/49)
X ray abnormalities	0% (0/20)	100% (38/38)	100% (49/49)

All data having different letters are differ significantly at $p < 0.01$

Table (3): Serum biochemical parameters in pneumonic goats compared to control group

Items	Control group Group I	Pneumonic goats		*P*-value
		Group II	Group III	
Vitamin D pg/ml	86.67 ± 4.055^{a}	76.33 ± 3.756^{a}	36.33 ± 2.028^{b}	0.000
Total protein gm/dl	7.807 ± 0.179^{a}	7.307 ± 0.147^{a}	6.373 ± 0.153^{b}	0.002
Albumin gm/dl	4.600 ± 0.100^{a}	3.007 ± 0.139^{b}	2.923 ± 0.252^{b}	0.001
Globulin gm/dl	3.207 ± 0.103^{b}	4.300 ± 0.265^{a}	3.450 ± 0.161^{b}	0.015
IgG mg/ml	32.17 ± 2.657^{b}	64.90 ± 13.91^{a}	23.17 ± 1.915^{b}	0.026
IgM mg/ml	2.150 ± 0.169^{ab}	2.627 ± 0.415^{a}	1.333 ± 0.240^{b}	0.049
IgA mg/ml	0.210 ± 0.012	0.267 ± 0.068	0.167 ± 0.030	0.328

Table (4): Pearson correlation coefficients between measured parameters

	parameters	Total protein	Albumin	globulin	IgG	IgM	IgA
Pearson Correlation	Total protein	1					
Sig. (2-tailed)	Total protein						
Pearson Correlation	Albumin	0.748	1				
Sig. (2-tailed)	Albumin	0.021					
Pearson Correlation	globulin	0.055	-0.622	1			
Sig. (2-tailed)	globulin	0.888	0.074				
Pearson Correlation	IgG	0.262	-0.266	0.709	1		
Sig. (2-tailed)	IgG	0.495	0.489	0.032			
Pearson Correlation	IgM	0.571	0.252	0.295	0.401	1	
Sig. (2-tailed)	IgM	0.109	0.514	0.441	0.284		
Pearson Correlation	IgA	0.167	0.040	0.137	0.161	0.735	1
Sig. (2-tailed)	IgA	0.668	0.919	0.726	0.679	0.024	
Pearson Correlation	Vitamin D	0.823	0.626	0.147	0.651	0.578	0.242
Sig. (2-tailed)	Vitamin D	0.002	0.071	0.706	0.035	0.103	0.531

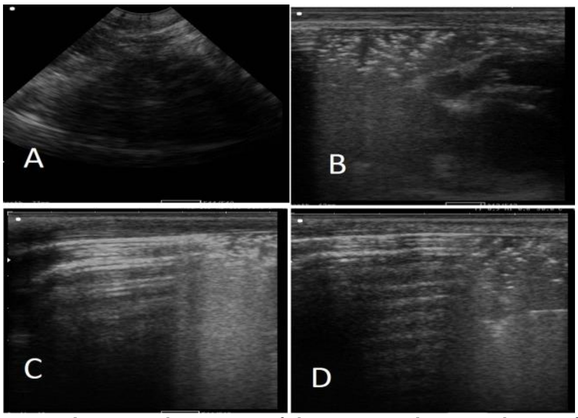

Fig. 1 Ultrasonographic imaging of the pneumonic lung. A: Absence of reverberation artifact and consolidation. B: Lung showed consolidation and pulmonary nodules appeared more echogenic. C:Inflamed part of the pleura appeared as localized echogenic spot followed by a comet tail artifact and lung lesion located more ventrally. D:Lung showed consolidation in pneumonic part and reverberation artifact of the normal part is visible dorsal to the lesion

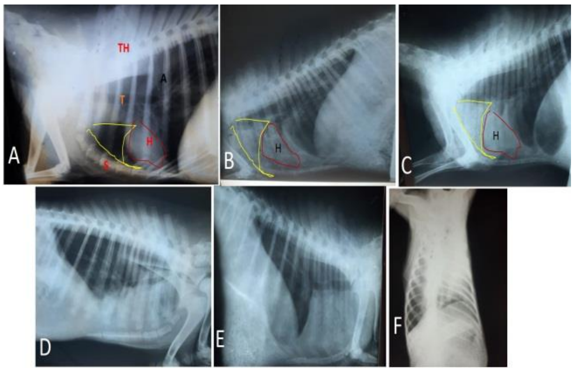

Fig. 2 Left lateral thoracic radiograph in normal goat, S= sternum, TH= thoracic spine, T= trachea, H= heart. A:Normal lung appeared as quite black. B-F: Alteration of pulmonary patterns in pneumonic goats by increase the radio opacity of the lung (arrows) that may be more gray or white

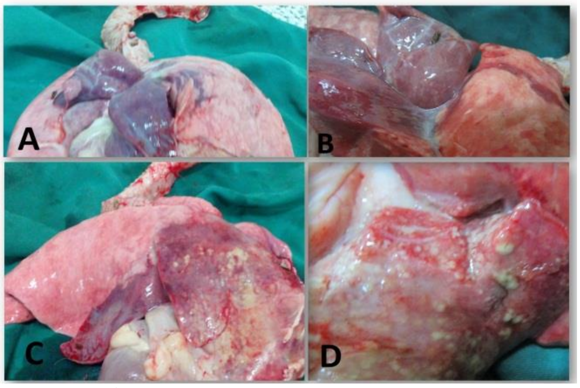

Fig.3. Lungs of goat. A and B: Bilateral hepatizations. C and D: Lung abscesses

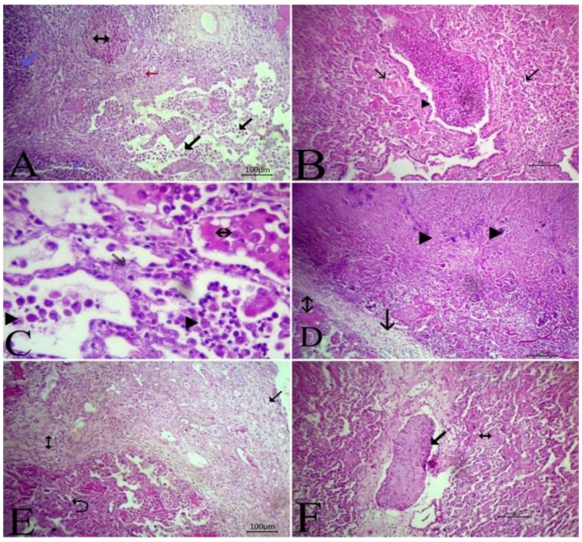

Fig.4. Sections of H&E-stained lung tissues of goats. A:Suppurative bronchopneumonia with suppurative foci in the pulmonary tissue (blue arrow) and bronchus with proliferation of its epithelium (arrow with 2 head), detachment of alveolar macrophages inside the lumen of alveoli (arrow), bare 100. B: Bronchioles showed suppurative exudate inside the lumen (arrowhead), alveoli filled with serous, fibrinous and suppurative exudate (arrows), bare 100.C:Some alveoli showing detached alveolar macrophages inside the alveolar lumen(arrowhead) with dilation of inter alveolar capillaries and neutrophils infiltration (arrow), other alveoli filled with serous exudates and alveolar macrophages (arrow with 2 head), bare 20. D: Caseated nodules with clusters of bacterial colonies in pulmonary tissue (arrowhead), thickening of pulmonary septa (arrow), some alveoli filled with serous exudate, bare 100. E: Thickening of the pleura (arrow) and pulmonary septa (arrow with 2 head) by fibrinous and suppurative exudates and were seen inside the alveoli (oblique arrow), bare 100. F:thrombotic masses inpulmonary vessels (arrow) with fibrinopurulent pneumonia (arrow with 2 head).Bar = 100µm

4. DISCUSSION

Pneumonia is a vital problem threatening small ruminant production, especially in developing countries. Studying the risk factors can minimize its effects on the possible losses among the flocks. Common risk factors as age, sex, season, sun exposure, health, immune status, and other environmental and management factors (housing with night shelter, muddy floor with a poor drainage system, and climatic factors as coldness during winter, sudden changes in weather had a direct influence on occurrence of pneumonia in goat (Di Provvido et al., 2018). In this study, the rate of pneumonia was higher in younger kids, winter season, and indoor rearing with insufficient exposure to the sun. This finding is obviously correlated with low vitamin D levels (Zhou et al., 2019). Females were more exposed to infection than males as in a previous study performed by Jarikre et al. (2016). Clinical signs were varied in severity from common signs of pyrexia, lethargy, anorexia, cough, nasal discharge, dyspnea to death (Tharwat and Al-Sobayil, 2017). Signs of illness and duration of symptoms were more in cases of low vitamin D levels than cases with normal vitamin D levels. The finding is proved that vitamin D level affects not only the occurrence of pneumonia but also the severity of the disease. Thus, the addition of vitamin D as supportive therapy in pneumonic goat may be is necessary, especially in indoor reared goats. The decrease in serum total protein and albumin may be attributed to anorexia as decreased albumin, a particular metabolic transporter protein, may indicate focusing the animals' metabolic activities toward synthesis protective proteins such as fibrinogen, haptoglobin, and serum amyloid acid to enhance the protective and healing function (Kaneko et al., 1997). Bacterial toxins may be responsible for hypoalbuminemia as it increases capillary permeability leading to plasma proteins escaping toward tissues with a subsequent decrease in the blood (Omran et al., 2005). The results were contrary to Saleh, and Allam (2014) who recorded a significant increase in serum total protein and globulin with a significant decrease in serum concentrations of albumin. Increasing IgG and IgM is predominantly recorded as a response to pneumonia thus their levels were comparatively higher in pneumonic goats with normal vitamin D levels than control ones. IgG was predominant in serum due to its neutralization power to bacterial exotoxins and viruses, opsonizing ability, and complement-fixing ability (Schroeder and Cavacini, 2010). Increasing IgM in pneumonic goats is associated with its complement-fixing ability to lyse microorganisms, agglutinating particulate antigens, clumping microorganisms for eventual elimination from the body (Hand and Reboldi, 2021). Non-significant changes in serum IgA were recorded between the three groups because it is secreted onto mucosal surfaces of the body, particularly the respiratory, intestinal, and urogenital tracts. It acts as an important first line of defense (Woof and AKerr, 2006). Moreover, the IgA structure and the associated secretory component allow IgA to survive the highly proteolytic environment of mucosal surfaces (Woof and AKerr, 2006). Normal vitamin D level was recorded in groups I and IIa that may be produced within animal skin during exposure to sunlight (Kohler et al., 2013). Normal vitamin D level with increased immunoglobulins and mild clinical signs were the obvious findings that support vitamin D impacts on the activity of the adaptive immune system (Aranow, 2011). Vitamin D activated form, 1, 25-(OH) 2D3, can bind with the VDR and stimulate the expression of antibacterial peptides that resist bacteria (White, 2010). A recent review demonstrated some pathways by which vitamin D decreases the risk of microbial infections (Gombart, 2020). Moreover, a recent study in humans also supported the role of vitamin D in decreasing the risk of COVID-19 infections and mortality (Nurshad, 2020). Ultrasonography, the lesions were easily differentiated from the bright linear reverberation artifacts of the normal lungs that appear in the control animals (Smith, 2017). Consolidation was observed as a firm texture mostly cranio-ventrally and frequently at both lungs. This finding indicates inhalation as a possible route of causative pathogens due to the abrupt and early branching of the bronchus (Zachary andMcGavin, 2011). The results contrasted with Tharwat and Al-Sobayil (2017) who observed consolidation mostly caudo-dorsally in the right lung suggesting a hematogenous route of infection and atypical pneumonia. In this study, ultrasound and chest x-ray were performed routinely upon admission. However, unlike radiography, ultrasonography requires no special restrictions or health and safety procedures. In current veterinary farm practice in which radiographic examination is impossible, ultrasonography is an available non-invasive diagnostic tool that is quickly implemented (Tharwatand Al-Sobayil, 2017). On the other hand, radiography as a non-invasive diagnostic imaging technique can be used for the diagnosis of thoracic diseases in goats (Makungu and Paulo, 2014). Visibility of the consolidated lung lobes as a percentage of total lung volume is very important for the case prognosis (Asare et al., 2016). The cranial part of the right lung was mostly affected as in a study conducted by Emikpe et al. (2013). Visualization of all lung lobes on lateral, dorsoventral, and Ventrodorsal views helped in the evaluation of lung patterns to diagnose pneumonia while comparison with normal radiography helped in the interpretation of lung patterns (Olatunji-Akioye et al., 2020). Radiography can characterize deep lesions within the lung when the periphery of the lung is normal (Reef et al., 1991). Chest x-ray and lung ultrasound should be complementary rather than used interchangeably in the diagnosis of pneumonia if possible, starting with radiography to recognize the site, size, and extent of the lesion. Then apply ultrasonography to obtain more details about the recognized lesions. In our study, the predominant histopathological findings were acute fibrinous bronchopneumonia followed by acute suppurative bronchopneumonia and interstitial pneumonia. In agreement with the findings of previous studies, fibrinous and suppurative bronchopneumonia was the most common types of pneumonia recorded in goats (Mishra et al., 2018 and El-Mashad et al., 2020). Histopathological study of pneumonic lungs by Rashid et al., (2013) recorded the highest prevalence of pulmonary lesions was bronchopneumonia (30%) and the second was pneumonia (25%) then hemorrhagic pneumonia (20%) and emphysema (15%) and the less commonly was purulent pneumonia (10%). While Mebibit el al. (2019) recorded that interstitial pneumonia was 41.9% followed by acute suppurative bronchopneumonia (25.7%), acute fibrinous bronchopneumonia (24.3%), chronic bronchopneumonia (6.1%) and bronchointerstitial pneumonia (3.4%). This difference with the previous study may be due to the calculation out of total examined goats, but this study was conducted only on affected lungs of dead goats. Increased rate of bronchopneumonia may be associated with the endemic state of pneumonic pasteurellosis and contagious caprinepleuropneumonia, that characterized by this type of inflammation, in Egypt among goat flocks (Abd-Elrahman et al., 2020 and Selim et al., 2021).The fibrino-suppurative inflammatory reactions are characteristic features for acute pulmonary infections due to Pasturella multocida (Ozyildiz et al., 2013 and Amin, 2020). The presence of neutrophils in the exudate of the pulmonary tissue describes the role of neutrophils in clearance of bacterial infection from the pulmonary tissue as a part of immune response (Thacker, 2006). The extensive exudation of the bronchial tree (lumen and wall) and alveoli by serous, fibrinous, and suppurative exudate may occur due to secondary bacterial spread in pulmonary tissue across respiratory tracts (Praveena et al., 2010).

5. CONCLUSION

In conclusion, caprine pneumonia was increased mostly in younger kids and among females during the winter season with insufficient sun exposure (23.7%and 79.6%) and poor husbandry. Vitamin D deficiency is an important predisposing factor for pneumonia in goats up to one year. Low vitamin D level is associated with increased incidence of caprine pneumonia. It is suggested that chest x ray and lung ultrasound should be complementary rather than used interchangeably in diagnosis of pneumonia in goats.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest for current data

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