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Pathological changes of liver and lung of slaughtered goats in Rajshahi Metropolitan area of Bangladesh

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ABSTRACT

A cross-sectional study was carried out in the abattoirs of the Rajshahi Metropolitan area from which a total of randomly selected 131 samples (70 livers and 61 lungs) of goats were investigated by gross and microscopic examination. The purpose of the study was to determine the status of vital organs e.g. liver and lungs of goats from a public health perspective. Among 131 samples, 12 samples (9.16%) showed gross changes in the liver and lungs. The changes in the liver were bulging, flaccid, and darkish discoloration with the loose turbid capsules. It contained hemorrhage, congestion with rounded corners, and nodular structure in one liver. Lung lesions were congestion, hemorrhage, fibrin deposition, and hepatization. Histo-pathologically, congestion of blood vessels, fibrosis, and immense leucocytic infiltration were observed in the affected liver. On the other hand, diffuse leucocytes mainly neutrophils infiltrated within the bronchioles and lung parenchyma in the affected lung were observed. These changes in the liver and lungs might be due to infectious and non-infectious agents. Percent lesions were 11.11%, 5.77%, 5.71% and 23.53% in 1-2, 2-3, 3-4 and >4 years of age respectively. Black Bengal goats were more affected (9.57%) compared to Jamunapari (8.11%) where female goats (10.34%) were more affected than male goats (6.82%). Goats were more affected in the rainy season (11.36%) compared to winter (8.7%) and summer (7.32%). The presence of lesions determined by gross and microscopic characteristics in this study deserves further investigation of causal agents to diagnose and surveillance of the prevailing diseases for ensuring food safety.

INTRODUCTION

Livestock is an integral component of the complex farming system in Bangladesh as it not only serves as a source of meat protein but also a major source of employment. In Bangladesh, small ruminants like goats make a valuable contribution, especially to the poor in the rural areas. But diseases are the main constraint to effective goat production. Both endemic and transboundary diseases result in morbidity and mortality and hence lower production (Arbabi et al., 2018).

The abattoir is the final destination for most goats and is the focal point in the farm-to-fork chain for meat products (Daniel et al., 2017). The need for food safety and disease control necessitates meat inspection (MI) at the abattoir. MI involves the screening of animals and meat for fitness for human consumption and is one of the most widely implemented and longest running systems of surveillance (Staaveren et al., 2019). This inspection provides necessary information for the scientific evaluation of pathological lesions. MI ensure to remove gross abnormalities from meat and its products, and prevent the distribution of contaminated meat thus assist in the detection and eradication of certain livestock diseases (Barbara et al., 2020) especially potentially zoonotic infections. The implications of zoonotic and emerging zoonotic diseases further emphasize the crucial role of information obtained from MI in the

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enhancement of public health and food safely. Monitoring disease and other conditions during slaughter inspection have been recognized as one important way of evaluating the disease status of a farm. Data obtained through meat inspection is a potential source of information and have an important role in epidemiology and preventive veterinary medicine.

Though liver and lungs are considered as favorable dishes, it may play an important role in spreading a lot of diseases. So postmortem examination of liver and lungs should be carried out as soon as possible after carcass dressing is completed. A lot of diseases bring specific lesions on liver and lungs of goat. For example, liver is commonly affected by various affections, e.g. telangiectasia, abscess, focal necrosis, cirrhosis as well as parasitic diseases; e.g. fascioliasis and hydatid disease whereas bovine cysticercosis, pleuritis, calcification, pneumonia, abscess, hemorrhages and lung worms were major causes of lung condemnation (Jaja et al., 2016). Therefore, postmortem of the liver and lungs is an easier technique for the diagnosis of diseases in developing country like Bangladesh. Considering these above views, the present research was designed to identify pathological lesions on liver and lungs during MI at abattoir to survey disease prevalence in goat reared in hot and humid area of Bangladesh.

MATERIALS AND METHODS

Ethical statements of experimental animals

During this study period, animals were slaughtered in halal and humane method. All goats were certified by the Department of Veterinary & Animal Sciences, Faculty of Veterinary & Animal Sciences, University of Rajshahi.

Sample collection and preparation

The liver and lungs of randomly selected 131 goats (94 Black Bengal and 37 Jamunapari goats) were collected from Shaheb Bazar, Ghoramara, Kazla and Binodpur Bazar of the Rajshahi metropolitan slaughterhouses area from August 2017 to July 2018. Among the selected goat 44 were male and 87 were female. The organs of the goats were examined immediately after humane slaughter in the early morning. Normal and abnormal conditions (like pale color, hemorrhagic spots, depression of any area, abnormal anatomical structures, etc.) were observed, and the photo was captured by Nikon digital camera. Health conditions, age, sex, and breed of the goats were recorded in a prescribed form. The age of the goats was determined following the dentition chart (Vatta et al., 2007). The sexes were determined by visual inspection of external genitalia. The breeds (Black Bengal and Jamunapari) were confirmed by the visual examination of body configuration, coat color, ear, and udder. For microscopic examination, representative tissue samples of both normal and abnormal parts of the liver and lungs were collected and immersed in 10% neutral buffered formalin and shifted to the Department of Veterinary and Animal Sciences, University of Rajshahi, and fixed for 24 hours.

Histopathology

The tissue samples were processed following standard procedures for histopathologic studies (Golbar et al., 2013). Briefly, the tissues were dehydrated through ascending grades of alcohol, cleared by three changes in xylene, and embedded in paraffin. The paraffin embedded tissues were cut at 5 µm in thickness using a semi-automatic rotary microtome (Mosbi^{TM}, China), stained routinely with Mayer's hematoxylin and Eosin (H&E) and examined under a light microscope. The images were taken using a photomicroscope (MBL-2100, Krüss, Germany with camera LC-20, Labomed, Inc., USA).

Statistical Analysis

Data obtained from the study were entered into a Microsoft Excel worksheet. The results were revealed as the mean ± standard error. The results were statistically analyzed by paired t-test using the SPSS software package (Version 20). $P<0.05$ was considered for statistical significance.

RESULTS

Among the selected goats only 12 (9.16%) showed both gross and microscopic lesions in liver and lungs (Table 1). Among the affected organs, 7

lesions were found in liver (5.34%) and 5 lesions in lung (3.81%) shown in table 5.

Lesions on the liver of examined goat

Normal livers from healthy control goats were roughly flattened, cuneate-shaped, and deep reddish-brown to chocolate in color (Figure 1A). The capsule was transparent and the surface was shiny (Figure 1B). But the size of the diseased liver was inflated than that of normal. The livers became swollen with blackish discoloration (Figure 1C). As a whole, the edges were rounded, and became bloated to touch. The capsule was whitish turbid, loose and torn than that of regular soft thin capsule. Cream-colored abnormal nodular structure was present in another liver (Figure 1D). Hemorrhagic spots dispersed over the parietal surface.

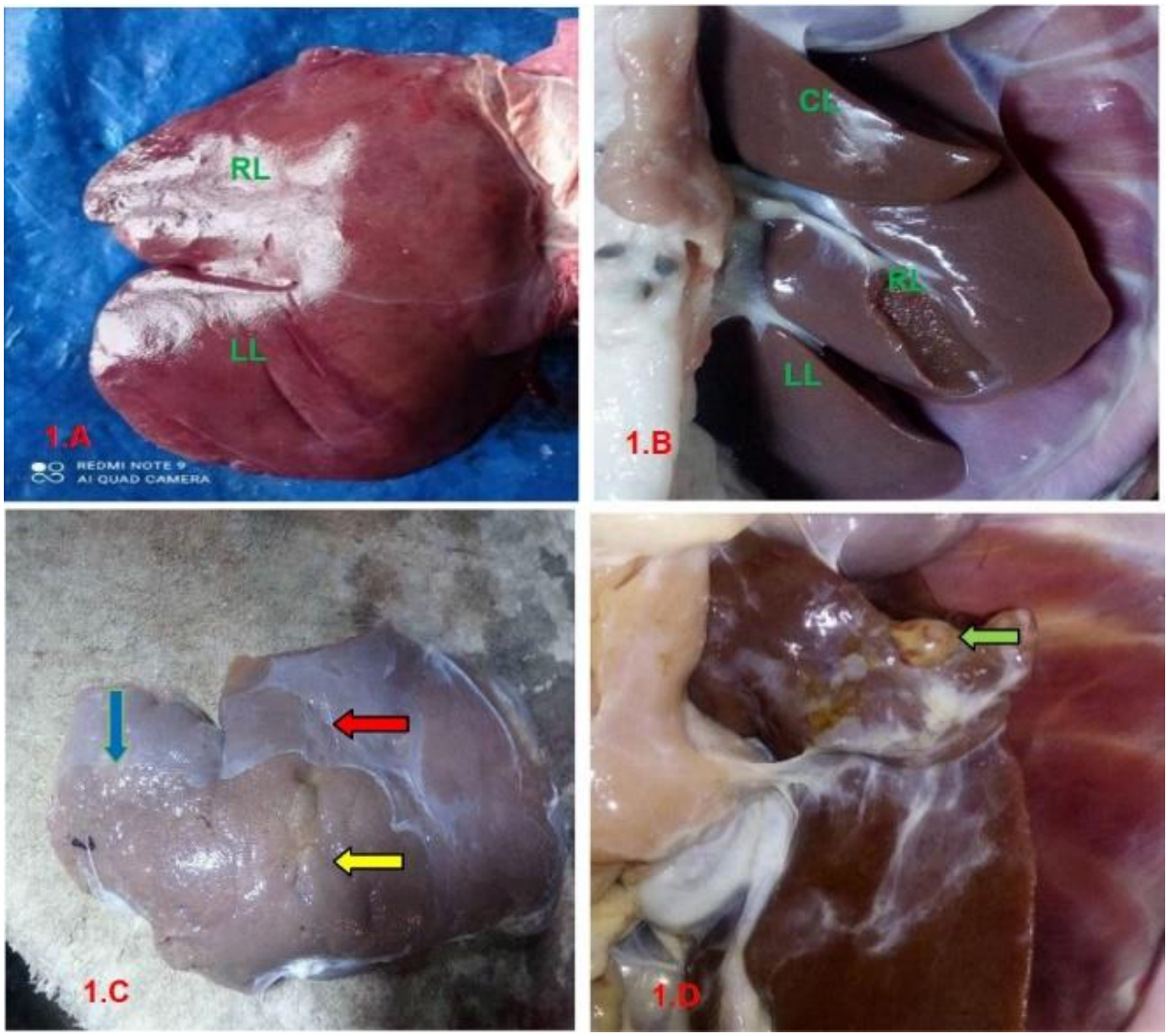

Figure 1: Gross lesions in livers of examined goats. A. Parietal surface of the normal liver of goat with deep reddish-brown color, B. Visceral surface of the normal liver of goat with different lobes of chocolate in color C. Flabby with Blackish discoloration (yellow arrow); round shape edge (blue arrow) and whitish loose, torn capsule (red arrow) D. Cream colored abnormal nodular structure (light green arrow).

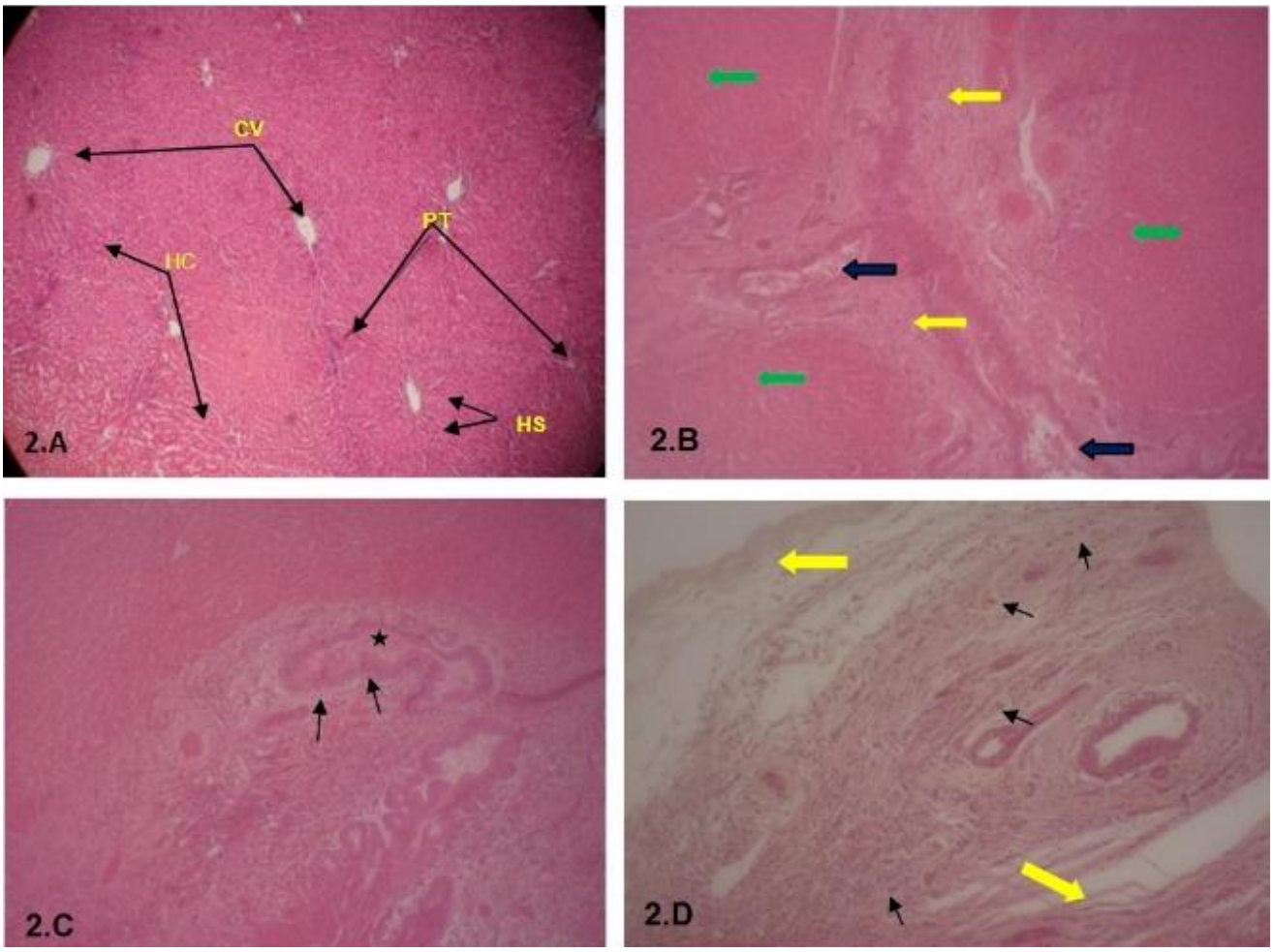

Figure 2: Microscopic lesions in livers of examined goats. A. Normal histology of goat liver was presenting central vein (CV) Hepatic cord (HC), Hepatic sinusoid (HS) and portal triad (PT). B. Severe fibrosis in the portal area (yellow arrow), blood vessels were congested (black arrow) between hepatic lobules (green arrow). C. Hypertrophy of the bile duct (asterisk) and mild fibrosis (arrow). D. Infiltration of leukocytes especially eosinophil and macrophage (black arrow) and severe fibrosis (yellow arrow).

Microscopically, numerous polygonal/hexagonal hepatic lobules were clearly found in normal liver. Hepatic lobules contain central vein at the middle and hepatic cords of hepatocytes diffract from the central vein towards the peripheries. The normal portal triad was made up of hepatic artery, portal vein, and a few bile ducts were clearly visible in control liver (Figure 2A). But the portal area showed microscopic changes in case of the affected liver. In the portal area, intense fibrosis was present due to *Fasciola* infection, the blood vessels were congested (Figure 2B). Bile duct proliferated heavily along with fibrosis indicating liver cirrhosis may be due to chronic fascioliasis (Figure 2C). Numerous numbers of leukocytes (eosinophil mixed with few lymphocytes and monocytes) infiltrated in the parenchyma accompanied by severe fibrosis (Figure 2D).

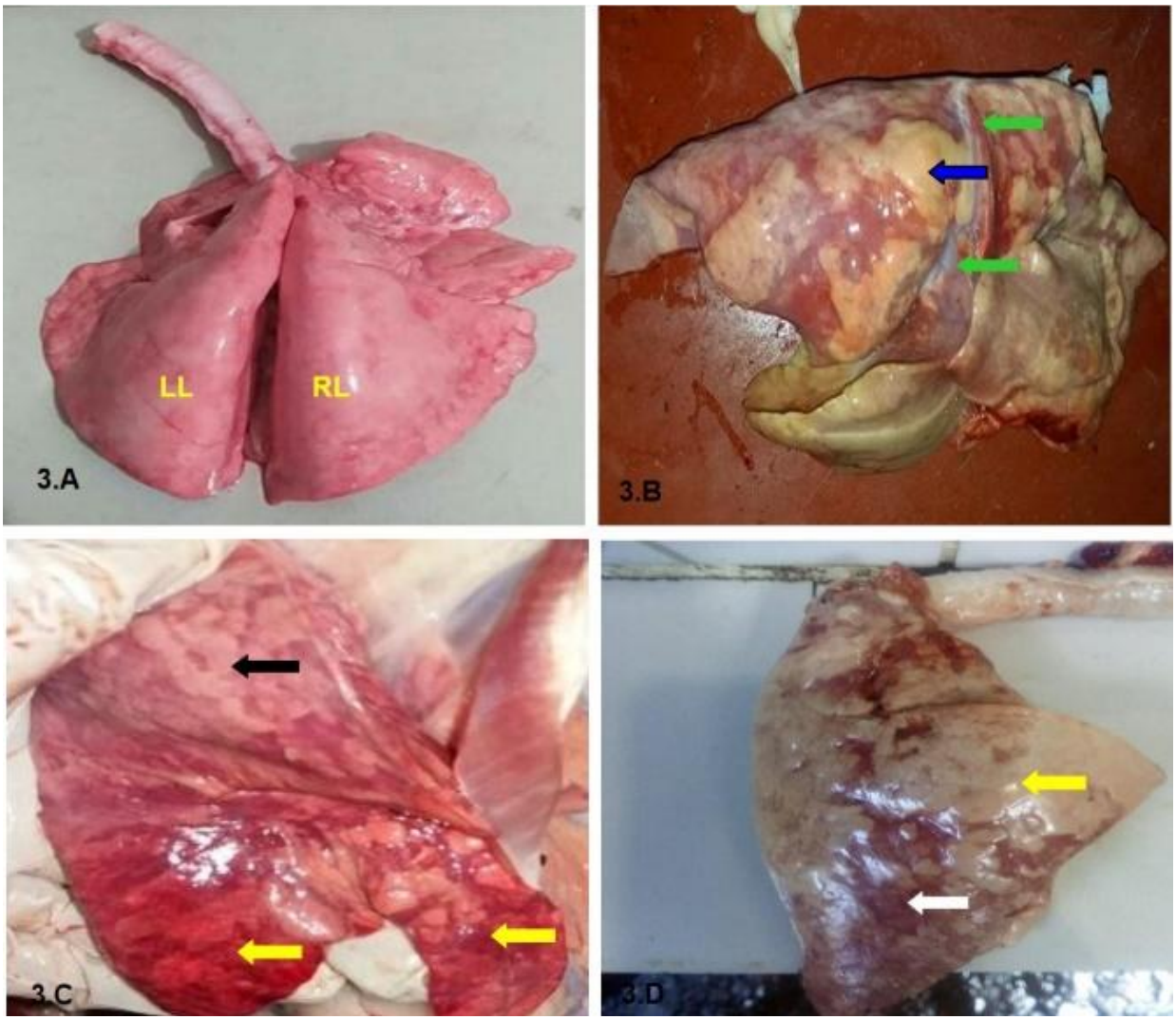

Figure 3: Gross lesions in lungs of examined goats. A. Normal lungs right (RL) and Left (LL) with brilliant pink color. B. Accumulation of pus (blue arrow) and fibrin deposition (Green arrow). C. Red colored, hemorrhagic, congested (yellow arrow) and slightly consolidated (black arrow) lung termed as red hepatization of lung. D. Dark discoloration (white arrow) with grayish consolidation of lung (yellow arrow).

Lesions on lungs of the examined goat

The lungs from control goats were lobulated and brilliant pink in color (Figure 3A). However, accumulation of pus and fibrin deposition over the surface of the lung was found in diseased lungs (Figure 3B). The lungs were stiffer to touch and were hemorrhagic, congested and slightly consolidated termed as red hepatization (Figure 3C). In some cases, the lung became consolidated on palpation; gray in color called gray hepatization (Figure 3D).

Microscopically, control lungs showed normal airways (bronchi/bronchioles) and alveoli (Figure 4A). But the accumulation of blood was present within the bronchiole and blood vessels of affected lungs. Infiltration of leucocytes mainly neutrophils were found in the wall as well as in the lumen of the bronchiole (Figure 4B). Diffuse infiltration of leucocytes with slight fibrin deposition (Figure 4C). Profuse number of inflammatory cells, mainly neutrophil infiltrated within the lung parenchyma (Figure 4D).

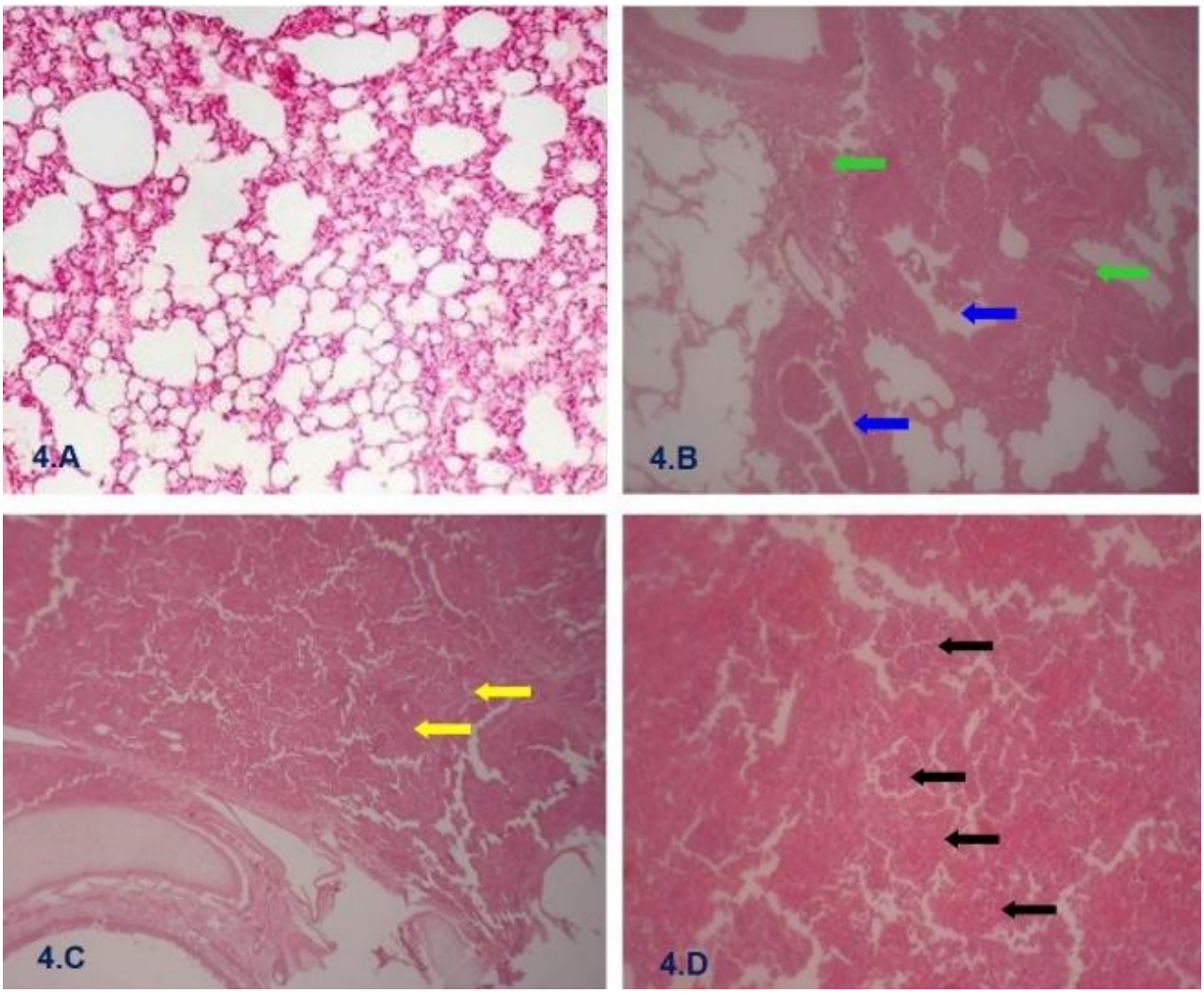

Figure 4: Microscopic lesions in lungs of examined goats. A. Normal histology of goat lung was showing alveolar sac, alveoli and pneumocytes. B. Accumulation of blood in bronchioles (Blue arrow), blood vessels were congested (green arrow) with accumulation of reactive cells. C. Defuse infiltration of reactive cells in lung parenchyma with slight fibrin deposition (blue arrow) D. Huge infiltration of reactive cells in lung parenchyma (black arrow).

Table 1: Age differences in prevalence of liver and lung lesion

Group No.	Age	No. of goat examined	No. of affected goat	Affected rate (%)
1	1-2 year	27	3	11.11
2	2-3 year	52	3	5.77
3	3-4 year	35	2	5.71
4	>4 years	17	4	23.53
Total		131	12	9.16

Table 2: Sex differences in prevalence of liver and lung lesion

Sex	Breed	Number of goats examined	Number of goats affected	Affected rate (%)
Male	Black Bengal	31	2	6.82
	Jamunapari	13	1	
Female	Black Bengal	63	7	10.34
	Jamunapari	24	2	
Total		131	12	9.16

Age, sex, breed, and seasonal differences in occurring liver and lung lesion

During the study, the experimental goats were allocated to four groups depending on age. An overall of 131 goats were explored; only 12 (9.16%) goats were unrolled with liver and lungs lesions (Table 1).

According to age, occurrences were 11.11%, 5.77%, 5.71%, 23.53% in 1-2 years, 2-3 years, 3-4 years and >4 years old goats, respectively shown in table 1. It was observed that affected rate was significantly highest in oldest (>4 years) followed by youngest (1-2 years) age groups whereas lower in 2-4 years' age groups. Manifestation of the liver and lung lesions were more in female than male goats. Black Bengal goats were more affected than Jamunapari goats (Table 2).

Table 3: Breed differences in occurrence of liver and lung lesion

S/N	Breeds of goats	Number of goats examined	Number of affected goats	Affected rate (%)
1	Black Bengal	94	9	9.57
2	Jamunapari	37	3	8.11
	Total	131	12	9.16

Table 4: Season differences in occurrence of liver and lung lesion

Breed	**Summer**			**Rainy**			**Winter**		
	Total goats Examined	Total goats affected	Affected (%)	Total goats Examined	Total goats affected	Affected (%)	Total goats Examined	Total goats affected	Affected rate (%)
Total	41	3	7.32	44	5	11.36	46	4	8.7

Table 5: Organ differences in occurrence of liver and lung lesion

No of Goat examined	No. of affected goat	% of affected goat	No. of Liver lesion	Liver lesions (%)	No. of Lung lesion	Lung lesions (%)
131	12	9.16	7	5.34	5	3.81

Among 131 goats, 94 goats (71.76%) were Black Bengal of which 9 (9.57%) were invaded by lesion on liver and lungs. On the other hand, out of 37 (28.24%) Jamunapari goats, 3 (8.11%) were found affected (Table 3).

It was noticeable from the study that the highest manifestation was recorded in the rainy seasons which was 11.36% followed by in winter (8.7%) and in summer (7.32%) (Table 4).

The liver and lung lesions varied organ to organ. It was found that among the affected goats occurrence of liver lesion (5.34%) was more than the liver lesion (3.81%).

There was significant differences among the affected goat in response to age ($P < 0.05$), sex ($P < 0.05$), Season ($P < 0.05$) and organ ($P < 0.05$). Whereas no significant difference was observed based on breed indicating all breeds examined were susceptible to liver and lung disordered (Table 6).

Table 6: Differences in affected goat based on age, breed, sex, season and organ

Points	Type	Mean±SE	Significance
Age-wise affected rate	Goat examined	32.75 ± 7.398	0.0070**
	Goat affected	3.000 ± 0.4082	(P < 0.05)
Breed-wise affected condition	Goat examined	65.50 ± 28.50	0.1735^{NS}
	Goat affected	6.000 ± 3.000	(P < 0.05)
Sex-wise affected condition	Goat examined	32.75 ± 10.74	0.0334*
	Goat affected	3.000 ± 1.354	(P < 0.05)
Season-wise affected condition	Goat examined	43.67 ± 1.453	< 0.0001***
	Goat affected	4.000 ± 0.5774	(P < 0.05)
Organ-wise affected rate	Goat examined	107.3 ± 11.86	0.0010***
	Goat affected (Liver)	4.667 ± 1.453	(P < 0.05)
	Goat examined	107.3 ± 11.86	0.0010***
	Goat affected (Lung)	3.333 ± 1.202	(P < 0.05)

DISCUSSION

Gross changes produced by *Fasciola gigantica* infection (Islam et al., 2015; Islam et al., 2016) were similar to some cases of this study. In case of affected liver, microscopic changes were found principally in the portal area where there was intense fibrosis. The blood vessels were congested may be due to *Fasciola* infection. Bile duct proliferated heavily along with fibrosis indicating liver cirrhosis may be due to chronic fascioliasis. Enormous reactive cells (eosinophil mixed with few lymphocytes and monocytes) infiltrated in the parenchyma accompanied by hemorrhage. This observation agreed with the microscopic changes observed in fascioliasis of goat (Islam et al., 2016; Parvin et al., 2020) and in deer (Masuduzzaman et al., 2005).

On the other hand, the affected lung was hemorrhagic, congested and slightly consolidated termed as red hepatization indicating acute pneumonia. In some cases, the lung became consolidated on palpation and a gray in color termed as gray hepatization pointing sub-acute to chronic pneumonia. Accumulation of pus and fibrin deposition over the surface of the lung was found indicating pleuro-pneumonia. These findings were similar with the findings of Rashid et al. (2013) and Ferdausi et al. (2008) who reported that the affected portion of lung was congested, consolidated and hard on palpation. (Mahdi et al., 2015) observed whitish to yellowish color fibrin over the affected lung surface.

In case of microscopic lesion, accumulation of blood within the bronchiole and blood vessels, infiltration of leucocytes mainly neutrophils in the bronchiole's wall as well as in the lumen of bronchiole was observed indicating bronchopneumonia. Diffuse infiltration of inflammatory cells within the lung parenchyma with slight fibrin deposition. Huge number of leucocytes mainly neutrophil infiltrated within the lung parenchyma signaling pleuo-pneumonia. These results have somewhat similarities with the

observations of Rashid et al. (2013), Ferdausi et al. (2008) and Mahdi et al. (2015).

This study revealed that oldest (> 4 years) goats were more affected with liver and lung lesion (23.53 %), followed by youngest goat (11.11%) than others. Poor health condition and malnutrition, stress of kidding, decreased immune function at advanced age may be the cause of high prevalence in >4 years' age group and underdeveloped immune system may be the cause in 1-2 years' age group. Age group (2-4 years) was less affected because of gradual development of immunity power. Our observation has similarity with that of Biobaku et al. (2018) and Matos et al. (2015). In this study Black Bengal goats showed little higher prevalence than Jamunapari may be due to bigger sample size of Black Bengal goat.

Liver and lungs lesions differ significantly between male and female animals in this study. Prevalence is more in female goats (10.34%) than the male goats (6.82%). Previous study also revealed that female goats are more prone to disease than male due to stress of kidding, milk yield rearing for longer period for breeding purposes (Hossain et al., 2011). It was worthy to note that prevalence of liver and lung lesions was significantly higher in rainy season (11.36%) due to parasite and intermediate host than that of winter (8.7%) and summer (7.32%). The observation of this study was supported by previous authors who stated that heavy rainfall and open grazing system might be the cause of higher incidence of *Fasciola gigantica* infection in rainy season than other seasons (Islam et al., 2014; Swai and Ulicky, 2009).

CONCLUSION

The findings of the study give an idea about the occurance and type of liver and lung lesions in Rajshahi regions of Bangladesh. Though the presentage of affection is not high, meat inspection activities should be strengthened. Hence further study is needed with bigger sample size and identification of causal agents to ensure safe meat production for human consumption.

Conflict of interest

The authors declare that there is no conflict of interests in publication of this work.

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