Contagious caprine pleuropneumonia (CCPP) is a highly fatal infectious disease of goats, caused by *Mycoplasma capricolum* subsp. *capripneumoniae* (*Mccp*). This disease is causing huge economic losses to the goat industry in Pakistan. However, little is known about the epidemiology of CCPP, especially in the hard areas of Khyber Pakhtunkhwa (KP), Pakistan, despite having a huge population of goats. Therefore, this study aimed to elucidate sero-molecular epidemiology and pathology associated with *Mccp* infection in goats in southern areas of KP including Dera Ismail Khan (DI Khan), Bannu, Karak, and Kohat. A total of 200 (50 from each area) serum samples were collected from clinically infected goats, whereas 600 various samples (nasal swab \( n = 50 \), pleural fluid \( n = 50 \), lungs \( n = 50 \) at each selected area of study) were collected from live goats showing respiratory clinical signs and dead/slaughter goats having lesions in the lungs/pleura. A commercial competitive ELISA kit confirmed anti-\*Mccp* antibodies in altogether 17% of serum samples, while area-wise seroprevalence was recorded as follows: Kohat, 28%, Bannu, 18%, DI Khan, 14%, and Karak, 8%. Moreover, a total of 5.5% of samples collected from clinically positive live and dead goats for \*Mccp* were found by species-specific PCR, whereas area-wise molecular prevalence of \*Mccp* was found in 3% samples from Kohat, 7.33%, Bannu, 6%, DI Khan, 5.33%, and Karak, 3.33%. Of 400 clinically examined goats, 242 (60%) had nasal discharge, 207 (51%) had pyrexia, 50.75% (203) had coughing, 48.25% (193) had pneumonia, 23% (92) had lacrimation, 7.75% (31) had pneumonia with lacrimation, and 10 (2.5%) showed all signs. Of the total 200 dead/slaughtered goats, pleural fluid was found in 36 goats and consolidation and red hepatization were observed in 40 and 42 goats, respectively. The present study found the presence of prevailing \*Mccp* strain in the goat population of the study area. The highest prevalence of \*Mccp* was found in collected samples from Kohat by ELISA. The highest seroprevalence of \*Mccp* was found in serum samples collected from Kohat by ELISA.

### 1. Introduction

In Pakistan, the livestock sector is dominated by the largest population of goats (Pakistan Economic Survey 2020-2021). Therefore, the goat is known as “poor’s man cow” in the subcontinent [1]. The most important threats to livestock population, especially goats, are respiratory diseases worldwide. Among respiratory infections, *Mycoplasma*-linked infections are responsible for massive economic losses in small ruminants in developing countries [2]. Mycoplasmas are the simplest self-replicating microorganisms, lacking a cell wall; however, they are highly species-specific and successful pathogens [3–5]. *Mycoplasma*-related infections are widely distributed all over the world, almost in all developing countries of Middle East Asia, South East Asia, and Africa [6, 7].
The most dreadful respiratory mycoplasmosis in goats is contagious caprine pleuropneumonia (CCPP). CCPP was first clinically reported in 1873 in Algeria [8]. Then, in 1881, CCPP was proved as a contagious infection in goats [9]. After a century, in 1976, the actual causative agent of CCPP, Mccp, was first isolated and characterized [10–12]. Mccp has been isolated from 13 countries but reported in 40 countries so far [13]. CCPP caused by Mccp is responsible for 100% morbidity and 60–80% mortality in goat flocks [14]. Mccp belongs to the Mycoplasma mycoides cluster. There are six species and subspecies in the Mycoplasma mycoides cluster [15], which causes disease in small ruminants as well as large ruminants. It shares multiple genomic properties or multiple phenotypic properties [16]. Mycoplasma mycoides cluster is further divided into two subgroups: Mycoides and Capri-colum. Mycoides are further divided into three subspecies; Mycoplasma mycoides subsp. mycoides small colony (MmmSC), Mycoplasma mycoides subsp. mycoides large colony (MmmLC), and Mycoplasma mycoides capri (Mmc). Capri-colum includes three subspecies: Mycoplasma capri-colum subsp. capri-colum (Mcc), Mycoplasma capri-colum subsp. capripneumoniae (Mccp), and Mycoplasma subsp. bovine 7th group (BG7) [12, 17]. The non-Mycoides cluster subspecies are Mycoplasma ovi-pneumoniae, Mycoplasma putrefaciens, and Mycoplasma agalactiae [7, 18].

Mycoplasma capri-colum subsp. capripneumoniae is a very fastidious slow-growing Mycoplasma with incubation time ranging from 7 to 10 days. The incubation may vary between 5 and 28 days. The first clinical sign of Mccp infection in goats is high body temperature (41°C) and reluctance to walk but the animal continues to feed intake. Then, the respiratory signs appear prominently with painful and deep respiration and frequent coughing. In the advanced stages, the animals are reluctant to move, continue salivation, and exhibit mucopurulent nasal discharge. In some cases, the animals have marked lameness, diarrhea, and nervous signs [19]. The gross pathological lesions associated with Mccp infection are restricted to the pleura and lung. The lungs are usually infected unilaterally, but bilateral infection has also been reported with CCPP [20]. There is massive red hepatization and pleurisy with fibrinous pleuropneumonia and straw-color pleural fluid. The necrotic areas on the lungs are sequestered and of black discoloration [19]. Histopathological lesions associated with Mccp infections are pulmonary emphysema, condensing of interlobular septa almost in all cases, and atelectasis [19, 21].

The identification of Mccp infection is difficult on the basis of clinical signs and symptoms because there is variation in clinical signs and symptoms [22]. Serological tests are most commonly used for the diagnosis of mycoplasmas. The common serological tests are growth inhibition test (GIT), indirect or passive haemagglutination assay (IHA/PHA), enzyme-linked immunosorbent assay (ELISA), complement fixation test (CFT), latex agglutination tests (LAT), and fluorescent antibodies test (FAT) [23–26].

Although the PCR is the most sensitive and accurate technique for the diagnosis of Mccp, it is a time-consuming, expensive technique and hardly detects Mccp in treated animals with antimicrobials. On the other hand, ELISA could diagnose the Mccp infection in treated animals as well as recovered animals. Therefore, we used a combination of serological, molecular, and pathological techniques for the detection of actual prevalence of Mccp local strain in goats in study areas.

2. Materials and Methods

2.1. Study Area. The current study was conducted in southern areas of Khyber Pakhtunkhwa including Khan, Bannu, Karak, and Kohat. These areas were visited for collection of samples from goats clinically suspected of CCPP.

2.2. Collection of Samples. Samples were collected from the suspected goat population in districts of Khan, Bannu, Karak, and Kohat of Khyber Pakhtunkhwa. A total of 800 samples were collected from clinically suspected and dead or slaughtered goats for CCPP. A total of 200 (50 from each area) serum samples were collected from clinically infected goats, whereas 600 various samples (nasal swab n = 50, pleural fluid n = 50, lungs n = 50 at each selected area of the study) were collected from live goats showing respiratory clinical signs and dead/slaughtered goats having lesions in the lungs/pleura. Blood samples were collected from the jugular vein for serodiagnosis of Mccp infection, whereas nasal swabs, lung tissue, and pleural fluid were collected from CCPP suspected goats for molecular detection of Mccp by PCR. Pleural fluid was collected in a sterile tube. Sterile cotton nasal swabs were inserted deep into the nasal passage to get the secretions of the goat. The lung tissue was collected in sterile sealable plastic bags and transported in an ice box to Pathology Laboratory, College of Veterinary Sciences, the University of Agriculture, Peshawar, and stored at −20°C or −86°C freezer until used. For histopathology, lung tissues were collected and transported in 10% buffered formalin to the laboratory.

2.3. Sero-Epidemiological Analysis of Mccp Infection by ELISA. The serum samples were tested with a commercially available competitive ELISA kit (IDEXX-USA). The manufacturer’s protocol was followed for cELISA.

2.4. Molecular Detection of Mccp by PCR

2.4.1. Genomic DNA Extraction and Quantification. Genomic DNA (gDNA) was extracted using GeneJET Genomic DNA Purification Kit made by Thermo Scientific, USA. The DNA extraction procedure was followed according to manufacturer instructions. The extracted gDNA was quantified with Nanodrop (Thermofisher-Finland). The DNA was diluted according to the desired level for PCR as reported elsewhere [27, 28].

2.4.2. Selection of Primers for PCR. The following set of primers was used for the detection of Mccp as reported previously [28–30]. Specific primers of Mycoplasma
2.4.3. Preparation of PCR and Conditions. PCR was performed using a PCR Thermal Cycler (Bio-Rad T100 USA). A total of 25 μl PCR reaction was prepared consisting of 1.75 μl forward primer and 1.75 μl reverse primer, 8 μl nuclease-free water, 10 μl PCR Master Mix, and 3.5 μl DNA template [28, 31]. Initial denaturation of template DNA was done at 94°C for 5 min followed by cycles of denaturation at 94°C for 30 sec, annealing at 53°C for 60 sec, and extension at 72°C for 90 sec and final extension was performed at 72°C for 5 min.

2.4.4. Gel Electrophoresis. PCR product was run on 1.5% agarose gel. After loading 6 μl of PCR products, including samples, positive control, negative control, and DNA ladder of 1 kb or 100 bp, agarose gel was run on the gel for 35 min at 120 V. The PCR products were visualized by the gel documentation system (FastGene, Germany).

2.5. Histopathological Study. Tissue samples (Trachea and lungs) were collected and preserved in 10% buffered formalin. Tissues were processed according to the standard protocol as adapted in [32, 33].

2.6. Statistical Analysis. All the data was collected and arranged in a Microsoft Excel worksheet. The collected data were then subjected to Statistical Package SPSS v20. A Chi-Square test was performed for analyzing the data.

3. Results

3.1. Seroprevalence of Mccp in Goats by ELISA. The ELISA was performed on 200 serum samples from goats for the detection of anti-Mccp antibodies. From Dera Ismail Khan, of 50 serum samples, 7 (14%) were positive for Mccp, whereas 18% of samples were positive from Bannu. Samples taken from Karak showed 8% positivity for Mccp. Interestingly, the highest number of samples (28%) positive for Mccp was found in the Kohat district. The overall seroprevalence of Mccp was found at 17% in southern areas of KP Pakistan. Statistical analysis by χ² showed a significant association (P > 0.05) among four districts (Tables 1–2, Figure 1).

3.2. Molecular Prevalence of Mccp in Goats in Southern Areas of KP by PCR. For the molecular prevalence of Mccp, PCR was performed on a total of 600 samples from southern areas of KPK, including 150 samples (50 nasal swabs, 50 pleural fluids, and 50 lung tissues) collected from each area, respectively (DI Khan, Bannu, Karak, and Kohat). The causative agent of CCPP was detected in 5% of samples from DI Khan, whereas 6% and 3% of samples were found positive for Mccp from Bannu and Karak, respectively. The molecular tool also detected the highest number (7%) of positive samples from the Kohat district. However, an overall molecular prevalence of Mccp was found at 6% in southern areas of KP (Tables 3–4, Figures 2–4).

3.3. Clinicopathological Study of Mycoplasma capricolum subsp. capripneumoniae

3.3.1. Clinical Manifestation of Mccp Infection in Goats. A total of 400 goats (100 in each district) were examined for clinical signs of CCPP including body temperature, coughing, nasal discharge, lacrimation, conjunctivitis, and arthritis. In a total of 400 goats, 242 (60.5%) animals showed nasal discharge, 51% exhibited pyrexia (103–104°F), 51% showed cough, and 48% showed signs of pneumonia. Conjunctivitis was recorded in 24% of animals, while lacrimation and arthritis were recorded in 23% and 3% animals, respectively. Only 8% of animals showed both pneumonia and lacrimation concomitantly, whereas 3% of animals showed all clinical signs mentioned above (Table 5, Figure 5).

3.3.2. Gross Pathology. Pathological investigations (gross and histopathological) were carried out on tissue samples from a total of 200 necropsied/slaughtered animals. The tissue samples were collected from different slaughterhouses. A total of 50 tissue samples were collected from each area (Dera Ismail Khan, Bannu, Karak, and Kohat). Lung tissue samples from animals (n = 26) at DI Khan were grossly normal, whereas samples from animals (n = 24) showed various gross lesions including consolidation of the affected lungs, red hepatization (unilateral), and adhesion of the lungs with the thoracic cavity. Tissue samples from animals (n = 34) at Bannu were grossly normal, whereas samples from 16 animals were infected showing pleural effusion (n = 9), red hepatization (n = 7), and adhesion of the lungs with the thoracic cavity (n = 9) from infected animals. From Karak, tissue samples from animals (n = 41) were grossly normal, while 9 animals who were grossly infected exhibited different lesions that includes pleural fluid (n = 4), red hepatization (n = 5), and adhesion of the lungs (n = 5). From Kohat, samples from 23 animals were normal, while 27 had gross lesions (Table 6, Figure 6).

3.3.3. Histopathology. From the total lung tissue samples collected from animals (n = 200), samples (n = 50) were collected from each area (Dera Ismail Khan, Bannu, Karak, and Kohat). From Khan, of 50 animal samples, only 12 animal tissue samples exhibited histopathological lesions including pulmonary emphysema, leucocyte infiltration, atelectasis, and thickening of interalveolar septa. Histopathological lesions have been observed in tissue samples from only six animals of 50 animals from Bannu, while samples from four animals of Karak exhibited similar...
Table 1: Seroprevalence of Mycoplasma capricolum subsp. capripneumoniae by cELISA in southern areas of Khyber Pakhtunkhwa.

| Area              | No. of samples | Positive samples | Negative samples | Prevalence (%) |
|-------------------|----------------|------------------|------------------|----------------|
| Dera Ismail Khan  | 50             | 7                | 43               | 14%            |
| Bannu             | 50             | 9                | 41               | 18%            |
| Karak             | 50             | 4                | 46               | 8%             |
| Kohat             | 50             | 14               | 36               | 28%            |
| Total             | 200            | 34               | 166              | 17%            |

Table 2: Statistical analysis of seroprevalence of Mycoplasma capricolum subsp. capripneumoniae by cELISA in southern areas of Khyber Pakhtunkhwa.

| Area    | ELISA-confirmed Mccp | Total | Chi-sq | P value |
|---------|-----------------------|-------|--------|---------|
| Khan    | Positive: 7 Negative: 43 Total: 50 Chi-sq: 7.52 P value: 0.05 |
| Bannu   | Positive: 9 Negative: 41 Total: 50 |
| Karak   | Positive: 4 Negative: 46 Total: 50 |
| Kohat   | Positive: 14 Negative: 36 Total: 50 |
| Total   | Positive: 34 Negative: 166 Total: 200 |

Statistical analysis by χ² showed significant association (P > 0.05) among four different districts.

Figure 1: Graphical representation of seroprevalence on cELISA in southern areas of KPK.

Table 3: Molecular identification of Mycoplasma capricolum subsp. capripneumoniae by PCR from the different clinical samples of goats in southern areas of Khyber Pakhtunkhwa, Pakistan.

| Area            | Samples        | No. of samples | PCR positive | PCR negative | PCR prevalence percentage |
|-----------------|----------------|----------------|--------------|--------------|---------------------------|
| Dera Ismail Khan| Nasal swab     | 50             | 2            | 48           | 4%                        |
|                 | Pleural fluid  | 50             | 3            | 47           | 6%                        |
|                 | Tissue         | 50             | 3            | 47           | 6%                        |
|                 | Total          | 150            | 8            | 142          | 5.33%                     |
| Bannu           | Nasal swab     | 50             | 2            | 48           | 4%                        |
|                 | Pleural fluid  | 50             | 5            | 45           | 10%                       |
|                 | Tissue         | 50             | 2            | 48           | 4%                        |
|                 | Total          | 150            | 9            | 141          | 6%                        |
| Karak           | Nasal swab     | 50             | 1            | 49           | 2%                        |
|                 | Pleural fluid  | 50             | 3            | 47           | 6%                        |
|                 | Tissue         | 50             | 1            | 49           | 2%                        |
|                 | Total          | 150            | 5            | 145          | 3.33%                     |
| Kohat           | Nasal swab     | 50             | 5            | 45           | 10%                       |
|                 | Pleural fluid  | 50             | 4            | 46           | 8%                        |
|                 | Tissue         | 50             | 2            | 48           | 6%                        |
|                 | Total          | 150            | 11           | 139          | 7.33%                     |
| Grand Total     |                | 600            | 33           | 567          | 5.5%                      |
Table 4: Statistical analysis of molecular identification of *Mycoplasma capricolum* subsp. *capripneumoniae* by PCR from the different clinical samples of goats in southern areas of Khyber Pakhtunkhwa, Pakistan.

| Area          | PCR confirmed Mccp | Total | Chi-sq | P value |
|---------------|--------------------|-------|--------|---------|
|               | Positive | Negative |       |         |
| Nasal swab    | 10   | 190      | 200   | 2.51    | 0.28    |
| Pleural fluid | 15   | 185      | 200   |         |         |
| Tissue        | 8     | 192      | 200   |         |         |
| Total         | 33    | 567      | 600   |         |         |

Statistical analysis by $\chi^2$ showed a nonsignificant association ($P > 0.05$) among three different types of samples.

Figure 2: PCR result of *Mycoplasma capricolum* subsp. *capripneumoniae* with an amplicon size of 316 in samples collected from goats. L = 1 Kb DNA ladder, samples = S1, S2, S3, S4, S5, S6, and S7, C = positive control, and N = negative control.

Figure 3: Graphical representation of sample-wise prevalence *Mycoplasma capricolum* subsp. *capripneumoniae* by PCR in southern areas of KPK.
Figure 4: Graphical representation of total prevalence of *Mycoplasma capricolum* subsp. *capripneumoniae* by PCR in southern areas of KPK.

Table 5: Percentage of clinical signs in naturally infected goats suffering from respiratory syndrome in southern areas of Khyber Pakhtunkhwa, Pakistan.

| S. no. | Clinical findings | Khan (n = 100) | Bannu (n = 100) | Karak (n = 100) | Kohat (n = 100) | Total (n = 400) | Sign (%) |
|--------|------------------|----------------|-----------------|-----------------|-----------------|----------------|---------|
| 1      | Pyrexia          | 56             | 51              | 43              | 57              | 207            | 51      |
| 2      | Cough            | 57             | 55              | 31              | 60              | 203            | 50.75   |
| 3      | Pneumonia        | 58             | 50              | 28              | 57              | 193            | 48.25   |
| 4      | Nasal discharge  | 70             | 62              | 37              | 73              | 242            | 60.5    |
| 5      | Lacrimation      | 20             | 17              | 23              | 32              | 92             | 23      |
| 6      | Conjunctivitis   | 29             | 23              | 19              | 26              | 97             | 24.25   |
| 7      | Arthritis        | 3              | 1               | 1               | 5               | 10             | 2.5     |
| 8      | Pneumonia + nasal discharge + lacrimation | 7 | 9 | 7 | 8 | 31 | 7.75 |
| 9      | All signs        | 3              | 1               | 1               | 5               | 10             | 2.5     |

Figure 5: (a) Nasal discharge and lacrimation. (b) Synovial joint swelling. (c) Nasal discharge, lacrimation, and fever. (d) Conjunctivitis.
lesions. From Kohat, 11 animal tissue samples were found to have pulmonary emphysema, leucocyte infiltration, atelectasis, and thickening of interalveolar septa (Table 7, Figures 7 and 8).

### 4. Discussion

Mycoplasmosis causes serious threat and massive economic losses in small ruminants (sheep and goats) in developing countries [2, 34, 35]. Mycoplasmosis causes high morbidity and mortality [2]. Mycoplasmosis is a pathogenic bacteria for multisystems and is collectively caused by *Mycoplasma mycoides* cluster. Mycoplasma is highly prevalent all over the world almost in all developing countries of Middle East Asia, South East Asia, and Africa [6, 7]. Mycoplasma is the smallest and slow-growing bacteria. It can cause disease in different species of animals and also cause disease in humans. Mycoplasma causes respiratory disorders, genital disorders, eye lesions, arthritis, and mastitis [36, 37]. Mycoplasmosis in goats is known as CCPP. The targeted area for Mccp in the host is the respiratory system and is restricted to the thoracic cavity [15].

**Table 6: Occurrence of gross pathological lesions in the thoracic cavity in naturally infected goats.**

| Areas   | No. of samples | Grossly normal | Straw color fluid/pleural fluid | Consolidated lungs/red hepatization | Cranio-ventral pneumonia/unilateral infected lungs |
|---------|----------------|----------------|---------------------------------|-----------------------------------|--------------------------------------------------|
| DL Khan | 50             | 26             | 11                              | 13                                | 13                                               |
| Bannu   | 50             | 34             | 9                               | 7                                 | 9                                                |
| Karak   | 50             | 41             | 4                               | 5                                 | 5                                                |
| Kohat   | 50             | 23             | 12                              | 15                                | 15                                               |

**Figure 6:** (a) Gross lesion in the lungs of a goat at post mortem examination suffering from respiratory symptoms suspected for Mccp. The lungs showing red hepatization, accumulation of pleural fluid, and haemorrhages (b). Gross lesion in lungs of a goat at post mortem examination suffering from the respiratory symptom suspected for Mccp. The lungs showing consolidation and accumulation of pleural fluid (c). Gross lesion in the lungs of a goat at post mortem examination suffering from the respiratory symptom suspected for Mccp. Accumulation of pleural fluid in pleural cavity (d). Gross lesion in the lungs of a goat at post mortem examination suffering from the respiratory symptom suspected for Mccp. The lungs showing consolidation and accumulation of pleural fluid collected with a sterile syringe.
The species-specific primers have enabled an advanced technique to be applied directly to the clinical samples, i.e., nasal swabs, fluid samples, and tissue samples [38, 39]. A total of 600 different samples were collected from naturally dead and slaughtered goats from different study areas. Of these, samples were subjected to PCR for the identification of *Mycoplasma capricolum* subsp. *capripneumoniae*. Of 600, only 33 samples were from nasal discharges, pleural fluids, and lung tissues. 10 (5%), 15 (7.5%), and 8 (4%) were detected with *Mycoplasma capricolum* subsp. *capripneumoniae*. Of 150 samples, 8 (5.33%) from Khan, 9 (6%) from Bannu, 5 (3.33%) from Karak, and 11 (7.33%) from Kohat were positive from nasal discharges, pleural fluid, and lung tissues on PCR analysis. The total positive percentage of *Mycoplasma capricolum* subsp. *capripneumoniae* on PCR was 5.5%. Similar studies were also conducted in [40–43]. The remaining samples were found negative on PCR. That might be due to other *Mycoplasma* cluster species that cause diseases in goats and them presenting similar clinical signs.

The cELISA results showed 17% overall seroprevalence at the southern areas of KP. Of 50 serum samples, 7 (14%) from DI Khan, 9 (18%) from Bannu, 4 (8%) from Karak, and 14 (28%) from Kohat were positive. The remaining 166 serum samples were negative on cELISA. The same study was reported in [34, 44, 45] in the northern areas (Swat and Buner) of KPK, Pakistan. But the results were in contrast because samples were collected randomly from goats, while in the current study, the serum samples were collected from suspected goats. It means that the disease is prevalent throughout the country. Area-wise distribution of the Mccep was more prevalent in Kohat as compared to Khan, Bannu, and Karak. The statement is justified by the inhabitant of the small ruminants of former nomads, constantly moving from place to place in search of pastures. The reason contributed to stress, which is predisposed to Mccep infection in goats. And these nomads cross the border easily and enter the area which leads to transboundary transmission of the disease; the same observation was also reported by the finding in [42].

The third objective of the work was the clinicopathological study of Mccep in southern areas of Khyber Pakhtunkhwa, Pakistan. In the present study, a total of 400 goats were examined for clinical signs and symptoms. The respiratory signs were common features for infected goats followed by pyrexia found in 207 (51%) goats, coughing in 203 (50.75%), pneumonia in 193 (48.25%), nasal discharge in 242 (60.5%), lacrimation in 92 (23%), arthritis in 97 (24.25%), and pyrexia, coughing, nasal discharge, and lacrimation combinedly found in 31 (7.75%), while all of the above signs were found in 10 (2.5%) goats. Similar signs were reported by many researchers [15, 34, 40, 46]. These findings are further supported by that of mycoplasma-infected goats showing high body temperature, painful respiration, and persistent cough [42]. It is justified that most of the *Mycoplasma* species present similar signs and symptoms.

Pathological lesions play an important role in the proper diagnosis of the disease. Pathological lesions provide evidence for pathologists to evaluate the severity of infection. The present study was carried out for the necropsy of a total

| Areas       | No. of samples | Pulmonary emphysema | Leucocytic infiltration | Atelectasis | Thickening of interlobular septa |
|-------------|----------------|---------------------|-------------------------|-------------|----------------------------------|
| DI Khan     | 50             | 12                  | 22                      | 8           | 10                               |
| Bannu       | 50             | 6                   | 16                      | 6           | 6                                |
| Karak       | 50             | 4                   | 9                       | 5           | 5                                |
| Kohat       | 50             | 11                  | 25                      | 11          | 13                               |

**Table 7:** Microscopic lesions in naturally infected goats suspected of *Mycoplasma capricolum* subsp. *capripneumoniae* across the southern areas of Khyber Pakhtunkhwa, Pakistan.
of 200 goats across the southern areas (Khan, Bannu, Karak, and Kohat) of Khyber Pakhtunkhwa. The lung lesion was recorded in 38% of dead/slaughtered goats comprising accumulation of straw-color fluid in the pleural cavity called pleural fluid (36 (18%)), consolidation, red hepatization (40 (20%)), cranio-ventral pneumonia, and unilateral infected lungs (42 (21%)) recorded in the thoracic cavity. The similar lesions were recorded in [19, 20, 40, 47, 48]. The Mccp infection is restricted to the thoracic cavity, and this is why the lesions are mainly limited to lung tissues. The histopathological lesions were found different in different lungs tissue samples from various number of goats including pulmonary emphysema was recorded in lung tissues rom 33 dead goats, leucocytic infiltration in 72, atelectasis in 30, and thickening of interlobular septa were observed in lung tissues from 34 goats. These observations were closely related to the findings of many researchers [19, 40, 42, 48–51].

5. Conclusion

*Mycoplasma capricolum* subsp. *capripneumoniae* (Mccp) was confirmed in southern areas of Khyber Pakhtunkhwa Pakistan by PCR and cELISA. PCR detected Mccp in 5.5% of goats in southern areas of Khyber Pakhtunkhwa. The cELISA kit detected antibodies against Mccp in 17% of goats in southern areas of Khyber Pakhtunkhwa. The highest prevalence of Mccp was found in collected samples from Kohat by PCR. The highest seroprevalence of Mccp was found in serum samples collected from Kohat by ELISA.

Data Availability

The data presented in this study are deposited and made publicly available in an acceptable repository, prior to publication.

Conflicts of Interest

The authors declares that they have no conflicts of interest.

Authors’ Contributions

FUR, and FAK designed and conceived the study. FUR, HK, FA, MS, QU, and MA carried out the research. FUR, FAK, and MA analyzed the data. FUR, FAK, and HK wrote the manuscript. FAK, and FUR critically reviewed and revised the manuscript.

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