Asian J. Med. Biol. Res. 2022, 8 (4), 270-276; https://doi.org/10.3329/ajmbr.v8i4.62504

Asian Journal of Medical and Biological Research
ISSN 2411-4472 (Print) 2412-5571 (Online)
https://www.ebupress.com/journal/ajmbr/

Article

Prevalence of *peste des petits ruminants* and concurrent hematological, liver and kidney function test of Black Bengal goats reared in Jaintapur, Sylhet district in Bangladesh

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Received: 29 October 2022/Accepted: 15 December 2022/Published: 28 December 2022

Abstract: Hemato-biochemical parameters aid in the formulation of effective treatment and supportive therapy for infectious diseases of animals such as *peste des petits ruminants* (PPR). The present study investigated the prevalence of PPR in Black Bengal goats reared in Jaintapur, Sylhet and concurrent hematology, liver and kidney function tests of PPR infected goats. Information of PPR infected goats was recorded according to age and sex by asking questions to the owner or farmers. Blood samples from 10 PPR-infected Black Bengal goats and 10 normal healthy goats were collected and analyzed using routine blood and biochemical tests. PPR positive cases were found in 60 of 125 goats examined based on clinical signs. The highest prevalence (50%) was recorded in young goats (below 12 months) followed by goats of 12-24 months of age and older goats (above 25 months). Older goats were less susceptible to PPR infection. Male goats were less susceptible to PPR infection (31.66%) compared to female goats (68.33%). PPR is more likely in goats with lower body condition score (BCS). PPR-infected goats had macrocytic hypochromic anemia, as evidenced by significantly lower TEC, Hb, and PCV levels and higher MCV and MCH levels. The total leucocyte count (TLC) was significantly ($P<0.05$) decreased, neutrophils numbers were significantly increased but lymphocyte numbers were decreased in PPR infected goats. ALT, AST and creatinine reflect the liver and kidney functions. PPR-infected goats had significantly higher ($P<0.05$) AST, ALT and creatinine values than normal healthy goats. A high level of AST and ALT in PPR-infected goats might be due to liver damage. The high creatinine level indicates functional damage to the kidney. In conclusion, Prevalence of PPR in higher in Black Bengal goats reared in Jaintapur, Sylhet and PPR virus altered the hematological parameters and liver and kidney function test of the PPR infected goats.

Keywords: PPR; Black Bengal goats; haemato-biochemical parameters

1. Introduction

Goats are referred to as “the poor man's cow” because of their enormous contribution to rural people's livelihood (Ahmed, 2017). They are primarily raised for meat, but various breeds of goats are frequently used as a source of milk and wool. Goat production requires little capital investment and low breeding stock costs. The goat hide helps the national economy. In Bangladesh in 2021-2022, there were approximately 26.7 million goats, with approximately 90% of them being Black Bengal goats (DLS, 2022). Peste des petits ruminants (PPR), is considered as one of the major constraints in sustainable goat farming in Bangladesh (Siddiky, 2013).

PPR is an acute, highly contagious viral disease that affects goat. The disease is also endemic in the Arabian Pennsylvania, the Middle East, Indian subcontinent, Turkey, Iraq, Iran, Afghanistan, Pakistan, India, Bhutan and Bangladesh (Rahman *et al.,* 2021; Muhammad *et al.,* 2010). The World Organization for Animal Health has recently been considered PPR as a serious notifiable and economically significant transboundary viral disease of sheep and goats with high morbidity and mortality (Folitse *et al*., 2017; Birindwa *et al*., 2017). In Bangladesh, the first outbreak of PPR was reported in 1993 (Islam *et al*., 2001). Since then, outbreaks of PPR have been reported on regular basis across the country (Begum *et al*., 2018; Bhuiyan *et al*., 2014; Rahman *et al*., 2011).

PPR virus transmission in nature mainly happens through direct contact with goats from low altitude pasture lands to high infected animals, as well as through inhalation of the infectious pasture lands in summer and the aerosol produced by a combination of sneezing and high altitude to low pasture lands in winter (Baazizi *et al*., 2017; Mahajan *et al*., 2013). Infection rates in goats increase with age, and the disease, which varies in severity, kills young animals quickly and has a controversial effect on the sex (Nargesi *et al*., 2012). PPR is clinically characterized by high fever, oculo-nasal discharges, necrotizing and erosive stomatitis, diarrhoea, and dyspnea bronchopneumonia which are followed by death or recovery from the disease (Jaisree *et al*., 2018; Balamurugan *et al*., 2012; Sharma *et al*., 2012). Animals that have not been immunized have a higher morbidity rate of up to 100% and mortality rates of 20% to 90%, especially in goats (Torsson *et al*., 2016). In some areas of Bangladesh, Black Bengal goats have a morbidity rate of 74.13 percent and a mortality rate of 54.83 percent (Das *et al*., 2007). The main risk factors for the presence or absence of PPR outbreaks are small stock management practices, seasons, transportation, and infected animals introduced into the goat flock. Aside from that, considerations of breed susceptibility, host immune competence, and existing parasitic infections aggravate the situation (Pope *et al*., 2013). Due to the absence of diagnostic tools it difficult to draw definite conclusions from disease studies where PPR outbreaks have been reported in the field. Hematology is an important and easier tool to disease diagnosis and very limited hematological parameter exists to compare PPR infected with non-infected goats (Begum *et al*., 2018).

Different diagnostic tests are used to diagnose the disease, ranging from the most basic form of observation of the presenting symptoms (tentative diagnosis) to a confirmatory diagnosis using serology or a molecular approach. Excluding clinical signs and history, hematology could be used for diagnosis, which is more useful in countries where diagnostic costs are regarded as expensive and burdensome (Tariq *et al*., 2014). The successful PPR control program was stalled due to insufficient veterinary services and diagnostic facilities (Haider *et al*., 2017). Acute PPR usually has a poor prognosis, especially when combined with secondary bacterial infection, poor nutrition, and other stresses. To prevent secondary bacterial infection, supportive therapy with fluid, electrolytes, and antibiotics can reduce PPR mortality (Yousuf *et al*., 2015). To develop appropriate supportive treatment, it is necessary to understand changes in the hemato-biochemical parameters of PPR-infected goats (Das *et al*., 2015). Furthermore, different treatment plans will be required based on hemato-biochemical changes at different stages of the disease.

Several studies have been conducted to assess hemato-biochemical alterations of goats infected with natural PPR outbreaks with conflicting findings (Das *et al*., 2015; Sharma *et al*., 2012). Therefore, the study was designed to determine the prevalence of PPR as well as to assess the hematological and liver and kidney function test of PPR affected Black Bengal goats reared in Jaintapur, Sylhet.

2. Materials and Methods

2.1. Study area and duration

A study was conducted on goats in Upazilla Veterinary Hospital Jaintapur, Sylhet to determine the general clinical prevalence of PPR in goats with the concurrent blood parameters during the period of six months (January to June, 2022). A total 125 suspected goats irrespective of different age, sex and breed were registered that came to the hospitals for treatment showing signs and symptoms.

2.2. Examination of the animals

Information of affected goats was recorded according to their age, sex and breed by carefully asking questions to the owner using a questionnaire form. Body condition score, temperature, high fever, stomatitis, oculo-nasal discharges, swollen lymph node, diarrhea, erosive lesions in mouth cavity and nasal cavity etc.

2.3. Collection of samples for hematology

Five ml of blood was collected aseptically from the jugular vein of goat (n=6) by sterile syringe. Blood sample was transferred to sterile test tube containing anticoagulant at a ratio of 1:10. All samples for hematological analysis were stored in 4˚C and tested within 24 h after collection.

2.4. Hematological parameters

The hematological parameters include i) Total Erythrocyte Count (TEC) (M/µl), ii) Total Leukocyte Count (TLC) (M/µl) iii) Hemoglobin Content (gm%), iv) Hematocrit Value (PCV %), v) Erythrocyte indices likes MCV (fl), MCH (Pg), MCHC (g/dl) and vi) Differential Leukocyte Count (DLC) were analyzed according to Ghai (2007) at the Department of Physiology, Bangladesh Agricultural University, Mymensingh.

2.5. Biochemical parameters

The biochemical parameters include i) ALT (IU/L), ii) AST (IU/L) and iii) creatinine (mg/dl) were performed colorimetrically using Humalyzer 2000 (Human type, Germany) following instructions provided (Zabir *et al.*, 2021).

2.6. Data analysis

All data were statistically analyzed using one-way ANOVA with post-hoc Tukey's test with GraphPad Prism 8 software.

3. Results and Discussion

3.1. Prevalence of PPR in Black Bengal goats

Out of 125 goats of different ages and sexes, 60 goats were PPR positive based on the clinical sign and symptoms of PPR (Table 1). Among the 60 (48%) PPR positive cases, below 12 months aged goats were 30 PPR positive, goats of 12-24 months aged were 25 and goats aged above 24 months were 5 cases. Results showed that the highest prevalence (50%) was recorded in young goats (below 12 months), whereas goats of 12-24 months of age were 41.66% and older goats (above 24 months) were 8.33 %. Data indicated that older goats were less susceptible to PPR infection. Among 60 goats, 19 male goats were found PPR positive. Male goats were less susceptible to PPR infection (31.66%) compared to female goats (68.33%). There was statistically significant (P<0.05) among the different age group and between male and female goats (Table 1).

Table 1. Prevalence of PPR in Black Bengal goats (n=125) in Jaintapur, Sylhet.

Parameters	Groups	PPR positive	PPR negative	Prevalence
Age	Below 12 months	30	20	50%*
	12-24 month	25	20	41.66%*
	Above 25 month	5	25	8.33%
Sex	Male	19	23	31.66%
	Female	41	42	68.33%*

*Values in a column of the table differ significantly at P<0.05 (below 12months vs. 12-24 month/ male vs female)

The current findings are coincided with the reports of Sarker and Islam (2011) and Singh *et al.* (2004). Goat kids over 4 to 12 month of age are most susceptible to the disease. It is reported that, in Pakistan, goats more than 12 months of age are more prevalent to PPR (Zahur *et al*., 2011; Torsson *et al*., 2016 and Folitse *et al*., 2017). Young animals are more susceptible might be due to lack of immunity, malnutrition and poor management system and matured goats might have strong immunity achieved by vaccination or exposed by previous PPR infection.

The current finding, in relation to sex, is agreed with the findings of Sarker and Islam (2011) and Torsson *et al.* (2017). They also found higher prevalence in female (28.52%) than male (13.04%) in Rajshahi, Bangladesh. Body condition score (BCS), immunity might be the cause of variation in the prevalence.

3.2. Physical examination of normal healthy and PPR infected Black Bengal goats

Body condition score (BCS) of normal goats was 3.2 ± 0.41 but in PPR affected goats the values were reduced to 2.2 ± 0.48 in the study areas (Table 2). Mean rectal temperature of PPR affected goats was 104.6 ± 0.97 whereas in normal goats, it was 101.6 ± 0.98. Heart rate and respiration rates were significantly higher in PPR affected goats (101.8 ± 3.29 and 48.2± 2.44) compared to those in normal goats (74.3 ± 3.43 and 21.10 ± 2.02). The present study revealed that goats with lower BCS are more susceptible to infectious diseases such as PPR. Rectal temperature, heart rate and respiratory rates are significantly (P<0.05) increased in the affected goats which are common features of PPR.

Table 2. Physical examination of normal and PPR infected Black Bengal goats.

Parameters	Normal healthy goats	PPR infected goats
BCS	3.2 ± 0.41	2.2 ± 0.48*
Rectal temperature	101.8 ± 0.92	104.6 ± 0.97*
Respiratory rate	21.10 ± 2.02	48.2± 2.44*
Heart rate	74.3 ± 3.43	101.8 ± 3.29*

*Values in a row of the table differ significantly at $P<0.05$ (Normal vs. PPR infected goats)

3.3. Hematological parameters of PPR infected goats

The mean total erythrocyte count (TEC) of normal healthy and PPR infected goats were 12.30 ± 0.74 million/µL and 6.16 ± 0.43 million/µL respectively (Table 3) and TEC was drastically decreased in PPR infected goats which was statistically significant at 5 % level ($P<0.05$). The mean hemoglobin (Hb) concentration was 14.87 ± 0.67 g% in normal healthy goats. In PPR infected goats, the value was 10.33 ± 0.56 g%. The value was higher in normal healthy goats and found statistically significant ($P<0.05$). The mean value of packed cell volume (PCV) was 39.72 ± 0.88 % in healthy goats but it was reduced to 32.8 ± 1.63 % in PPR infected goats. The values was statistically significant ($P<0.05$).

Table 3. Hematological parameters in PPR infected goats (n=10).

Parameters	Normal healthy goats	PPR infected goats
TEC (10^6/µL)	12.30 ± 0.74	6.16 ± 0.43*
TLC(10^3/µL)	10.6 ± 0.47	7.48 ± 0.75*
Hb (g %)	14.87 ± 0.67	10.33 ± 0.56*
PCV (%)	39.72 ± 0.88	32.8 ± 1.63*
MCV (fl)	32.70 ± 1.70	55.05 ± 5.75*
MCH (pg)	13.40 ± 0.54	21.26 ± 2.20*
MCHC (g%)	41.12 ± 0.98	38.99 ± 2.25*
Neutrophils (%)	33.2 ± 2.08	59.60 ± 2.92*
Eosinophils (%)	3.66 ± 0.73	3.60 ± 0.40^{ns}
Basophils (%)	00.00 ± 0.0	00.00 ± 0.0
Lymphocytes (%)	60.66 ± 2.20	35.50 ± 2.11^{*}
Monocytes (%)	2.50 ± 0.47	1.80 ± 0.38^{ns}

*Values in a row of the table differ significantly at $P<0.05$ (Normal vs. PPR infected goats)

The total leucocyte count was 10.6 ± 0.47 thousand/µL in normal healthy goats and 7.48 ± 0.75 thousand/µL in PPR infected goats. TLC was significantly ($P<0.05$) decreased in PPR infected goats as compared to healthy goats. Similar findings were also observed by other researchers (Sharma *et al*., 2012; Bari *et al*., 2018; Islam *et al*., 2018). PPR virus is lymphotropic nature and it inhibits peripheral blood lymphocytes proliferation (Maina *et al*., 2015). The present findings are matched with the findings of Shaikat *et al.* (2013). Geerts *et al.* (2001) supported the reduction of TEC, Hb and PCV in diseased animal. In diseased animal, TEC, Hb and PCV reduce due to infection, anemia, abdominal ulcer, immune precipitation and deficiency of nutrition (Durrani *et al*., 2006). The current findings are consistent with the finding of Bari *et al.* (2018). They reported that TEC, TLC, Hb, PCV were decreased in PPR infected goat. Similar findings were also reported by Sahinduran *et al*. (2012), Das *et al*. (2015) and Begum *et al*. (2018).

The values of mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) were 32.70 ±1.7 fl, 13.40 ± 0.54 pg, and 41.12 ±0.98 g% in normal healthy goats but 55.05 ± 5.75 fl, 21.26 ± 2.20 pg and 38.99 ± 2.25 g% respectively in PPR infected goats (Table 3). MCV and MCH values were significantly ($p<0.01$) increased in PPR infected goats. The current RBC indices findings indicated that PPR infected goats were suffering from macrocyctic hypochromic anemia which could be due to nutritional deficiency.

In case of differential leukocyte count (DLC), neutrophils, lymphocytes, monocytes and eosinophils counts were 33.2 ± 2.08%, 60.66 ± 2.20%, 2.5 ± 0.47% and 3.66 ± 0.73% respectively in normal healthy goats but in PPR infected goats the values 59.6±2.92%, 35.50 ± 2.11%, 1.80 ± 0.38% and 3.60 ± 0.40% (Table 3). In PPR-infected goats, neutrophils were significantly increased while lymphocyte numbers were decreased. Similar observations was found by several researchers (Aziz *et al*., 2019; Ugochukwu *et al*., 2018; Balogun *et al*., 2017; Maina *et al*., 2015; Sahinduran *et al*., 2012; Sharma *et al*., 2012). As PPR virus is lymphotrophic in nature,

lymphopenia might occurred due to necrosis of the lymphocytes in lymph nodes, spleen and peyer's patches. The current findings are not similar to the findings of Bari *et al*., 2018 which stated that lymphocytes were increased and neutrophils number were decreased in PPR-infected goats. Acute physiological stress response caused by infection such as PPR is accompanied by increased lymphopenia and neutrophila.

3.4. Liver and kidney function tests of PPR infected goats

Serum alanine aminotransferase (ALT) and aspartate aminotransferase (AST) are normally found in the liver, but when liver is damaged these parameters are found in high concentration. PPR-infected goats had significantly higher ALT, AST and creatinine values (39.12 ± 3.61 u/l, 24.8 ± 1.94 u/l and 1.25 ± 0.110 mg/dl) than normal healthy goats (19.03 ± 2.77 u/l, 16.66 ± 1.10 u/l and 0.63 ± 0.063 mg/dl) (Figure 1). The results are comparable to those of Aziz *et al*. (2019), Begum *et al*. (2018) and Balogun *et al*. (2017). A high level of AST, ALT in PPR-infected goats might be due to liver damage. Creatinine are found in high concentrations in the serum when the kidney is damaged by infection, such as in PPR infection (Figure 1). The findings are consistent with those of Aziz *et al.* (2019) and Balogun *et al.* (2017). A higher creatinine level indicates that the virus has a stronger preference for kidneys.

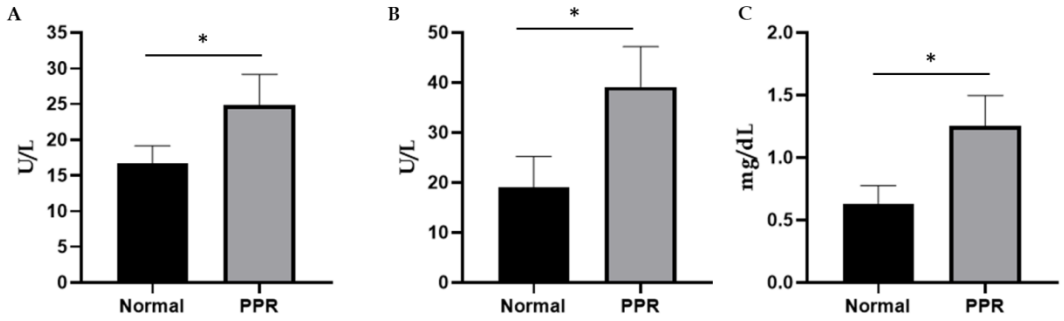

Figure 1. Liver and kidney function tests in PPR infected goats. A), AST; B) ALT and C) Creatinine. * *P*<0.05 (normal versus PPR).

4. Conclusions

The prevalence of PPR in Black Bengal goats reared in Jaintapur, Sylhet and concurrent hematological and liver and kidney function tests were investigated. PPR positive cases were found in 60 of 125 goats. Young goats had the highest prevalence followed by goats aged 12-24 months of age and older goats (above 25 months). Female goats with lower BCS were more susceptible to PPR infection. Hematological values were drastically decreased except the MCV and MCH which significantly ($p<0.05$) increased in PPR-infected goats. PPR-infected goats were suffering from macrocytic hypochromic anemia. In PPR-infected goats, neutrophils were significantly increased while lymphocyte numbers were decreased. The AST, ALT and creatinine had significantly higher in PPR-infected goats than normal healthy goats. It concludes that the hemato-biochemical parameters would be valuable tools for diagnosis and could aid in the rapid administration of supportive therapy in PPR infection.

Acknowledgements

The authors would like to acknowledge the office staffs of the Upzilla Veterinary Hospital, Jaintapur, Sylhet.

Data availability

All relevant data are within the manuscript.

Conflict of interest

None to declare.

Authors' contribution

Mohammad Alam Miah: designed the experiment, supervised it, analyzed data and revised the final draft of the manuscript; Md. Saif Uddin and Sajibul Hasan: carried out the experiment, data analyzed and wrote the first draft of the manuscript. All authors have read and approved the final manuscript.

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