Original Article

Buffalo Bulletin (April-June 2024) Vol.43 No.2
https://doi.org/10.56825/bufbu.2024.4324548

OCCURRENCE PATTERN OF DIAPHRAGMATIC HERNIA IN BOVINES

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Received: 22 August 2021
Accepted: 24 June 2024

ABSTRACT

The present study was done with an objective to evaluate the occurrence pattern of diaphragmatic hernia in Bovines. All the bovines presented with and positive for diaphragmatic hernia (n=162) on radiography or ultrasonography were included in the study period of 15 months. The overall hospital and radiographic occurrence of diaphragmatic hernia in bovines was 2.22% and 11.96% respectively. The highest radiographic occurrence of DH was in the month of December (21.21%) followed by in February (20.41%) and the least was in September (0.89%).

The study included 159 buffaloes and 3 cows. Among buffaloes, 2 were males (1.26%) and the rest females. All the cows presented were females; 2 cows were of indigenous Sahiwal breed, and one was a Jersy cross bred. Most of the bovines (72.22%) were presented in a period of 8 to 30 days of appearance of clinical signs. The average age of bovines presented was 5.87±2.21 (2-14) years, body weight 391.39±69.72 (204-560) kg, Body condition score 1.69±0.67 (1-3.5), in-appetence in 96.30%, recurrent bloat in 67.29%, hard black scanty faeces in 85.80%, occasional coughing in 9.87% and mild brisket oedema in 4.94%. The 40.74% of bovines were non-pregnant (with 28.79% recently parturited) and 59.26% (with 38.64% in advance pregnancy) were in some stage of pregnancy.

The average heart rate of bovines was 72.08±16.31 (43-120) beats/min, respiration rate 22.52±11.31 (5-60)/minute and temperature 100.43±1.88 (95-106)°F. Most of the bovines (82.10%) were active and alert with pink mucous membrane (59.29%), one was presented recumbent and 17.28% were dull and depressed. The average haemoglobin in g% was 10.38±2.41 (3.5-17.4) with maximum bovines had haemoglobin between 10 to 12 g% (37.24%). Only 67% bovines had potential foreign bodies in cranial or caudal reticular regions on recumbent radiography.

In conclusion, the radiographic occurrence of diaphragmatic hernia in buffaloes is alarming; however, the cows and male buffaloes are rarely reported. The existence of DH in indigenous cows is reported. The young adult female buffaloes are maximum susceptible to the disease condition of diaphragmatic hernia. Reduced BCS and body weight due to chronic in appetence is characteristic of non-pregnant diaphragmatic hernia Bovines. Passage of hard scanty faeces and in-appetence was a characteristic of the condition, however,

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recurrent bloat, advance pregnancy and presence of potential foreign body on radiograph was not a characteristic feature of diaphragmatic hernia in bovines.

Keywords: *Bubalus bubalis*, buffaloes, cows, potential foreign body, recurrent bloat, scanty faeces

INTRODUCTION

Diaphragmatic hernia is a surgical condition of buffaloes, where there is a rent in the diaphragm, mostly on the right ventral hemi-diaphragm at the musculo-tendinous junction (Singh *et al*., 1980) and the reticulum gets herniated into the chest. The condition presented in buffaloes is acquired but not with the history of direct trauma or fall (Singh *et al*., 1980). A lot of work has been done on the diagnosis and surgical correction of DH in bovines. The condition is highly prevalent in northern India due to high population of buffaloes in this region. Earlier studies also report a high radiographic occurrence of up to 40% in buffaloes (Singh *et al*., 1980) and rare in cows (Saini *et al*., 2000; Saini *et al*., 2007). With the refined techniques of radiography and ultrasonography for the diagnosis of DH, the occurrence pattern of diaphragmatic hernia and its characteristic clinical features have changed with time. The present study was designed with the objective to evaluate the occurrence pattern of diaphragmatic hernia in the bovines of northern India.

MATERIALS AND METHODS

The present study was conducted on the bovines presented to the University Veterinary Hospital and confirmed for diaphragmatic hernia (DH) on radiography (Kumar and Saini, 2012; Jaiswal *et al*., 2018); or ultrasonography (Mohindroo *et al*., 2007; Kumar and Saini, 2011; Kumar *et al*., 2017) or rumenotomy. The study was duly approved by the Institutional Animal Ethics Committee.

The signalment observations of species, age, gender, body weight (in Kg) and body conditioning score (BCS) were recorded. The body condition score of the bovines was classified as per Singh *et al*., 2017. History regarding feed/water intake, pregnancy/parturition status, bloat, and fever, type of faeces, any respiratory problem and duration of illness was recorded. The clinical parameters of heart rate, respiration rate, body temperature and the general state of the bovine (alert, dull), mucous membrane, and blood haemoglobin level in g% were also recorded.

Statistical analysis

The data generated was statistically analysis using Microsoft Office Excel, 2007. The mean and the standard deviation of all the numerical parameters were calculated in all the bovines.

RESULTS AND DISCUSSIONS

Hospital and radiographic occurrence of DH (Table 1, Figure 1)

A total no. of 7300 bovines were registered in the hospital in the study period of 15 months (February 2020 to May 2021). It was more than one year study, as it included 3 months of lockdown (March, April and May 2020) when the case of DH was less presented. Out of 7300 bovines

presented, 162 bovines were diagnosed for DH during this 15-month period. Therefore, the hospital occurrence of DH in 2020 to 2021 was 2.22% (162/7300) with the highest occurrence of 5.01% in December (21/419) and the least of 0.16% in September 2020 (1/632).

A total of 1355 radiographs of the reticulum were made for the bovines in the study period. The radiographic occurrence of DH in the study period was 11.96% (162/1355). Similar to the hospital occurrence, the highest radiographic occurrence of DH was 21.21% in December 2020 (21/99) and the least was 0.89% in September 2020, where only one case of DH was presented out of total 112 radiographs made. DH has been reported to be an acquired condition with the radiographic incidence of as high as 40% in buffaloes, though at that time a limited number of bovines underwent radiography (Singh *et al*., 1980).

Signalment, history, clinical and physical signs of bovines presented with Diaphragmatic hernia in bovines (Table 2)

The average age of bovines presented for DH was 5.87±2.21 (2-14) years with a maximum number of bovines affected in young age, during first parity (3 to 5 years of age), followed by those between 5 to 8 years of age, making a total occurrence for the 3 to 8 years group to be 78.39%. Earlier studies have also reported the Age group of 5 to 8 years to be most susceptible (Saini *et al*., 2001; Athar *et al*., 2010). Even adult buffaloes of more than 8 years of age and up to 14 years were also presented with DH, though the percentage was quite low 9.88%. One female buffalo calf of 2 years of age was also presented. The sub-adult buffaloes included 11.11% of occurrence (2 to 3 years of age). Among the 3 cows presented, 2 were of 4 years and one 10 years. Both the male buffalo bulls presented were young of 4 and 3 years of age.

The average body weight of DH bovines presented was 391.39±69.72 (204 to 560) kgs with a maximum no. of bovines falling in the range of 301 to 400 kg (43.21%) followed by 401 to 500 kg (38.89%). A small % of buffaloes (6.795) were more than 500 kgs and 11.11% between 200 to 300 kgs. Since DH is a chronic condition, the disease slowly debilitates the bovine, and thus reducing the body weight and an average weight of nearly 300 to 450 kgs has been reported earlier also (Abouelnasr *et al*., 2012).

The average body condition score (BCS) was 1.69±0.67 (1 to 3.5) with maximum falling in 1.5 and 2 BCS (47.53%), followed by those having BCS 1 (33.33%). The 2.5 and 3 BCS was found in only 17.90% bovines followed by only 2 bovines with 3.5 BCS. The BCS of 2.5, 3, and 3.5 was mostly seen in bovines in advance pregnancy or recently parturited. Among cows, 2 cows were weak with BCS of 1 and 1.5, while the one operated had 3.5BCS. Both the males presented were weak with BCS 1.5 and 2.

The average heart rate of bovines with DH was 72.08±16.31 (43 to 120)/minute. The average heart of clinically healthy buffaloes in summer season in Indian conditions is reported to be 67.65 bpm (Singh *et al*., 2014). The buffaloes of the study had on an average the heart rate within the normal range, except for few where it was markedly increased which may be due to the pressure on the heart and associated lung problem due to drenching of medicines.

The average respiration rate was recorded to be 22.52±11.31 (5-60)/minute which was slightly higher than the RR in normal buffaloes which is 18.77 and 12.29 breaths/min in summer and winter season respectively (Singh *et al*., 2014). The average temperature was 100.43±1.88 (95-106)°F,

which was towards to lower side, which may be because most of the buffaloes presented with DH do not have a history of fever and have sub-normal temperature due to chronic illness. The average rectal temperature in clinically healthy buffaloes is reported to be 102.52 and 100.68°F in summer and winter season (Singh *et al*., 2014). A few buffaloes had a history of fever (6.79%) or may be hyperthermia when travelling in hot weather; however, fever is not the clinical sign of DH (Singh *et al*., 1977).

One of the characteristic features of the DH buffaloes was their active and alert behaviour even after low BCS and chronic illness, which may be due to that these buffaloes are rarely completely off-feed (3.70%) and usually take a small quantity of feed and water (96.30%). Partial anorexia has also been reported in previous studies (Saini *et al*., 2001). Moreover, it is hypothesized that the herniated and adhered reticulum irritates the animal and lead to hyperactivity to bring it back in abdomen. In the present study, 82.10% of bovines were active and alert at the time of presentation. Although one was presented recumbent and 17.28% were dull and depressed. The chronically ill bovines were mostly dehydrated with sunken eyeballs. But the mucous membrane in most of the bovines was pink (59.26%) or congested (17.90%) and pale in a few (22.84%).

Due to the entrapment of rumeno-reticular groove or occasional obstruction of the cardia, as the herniated reticulum pushes it inside, the recurrent bloat was a regular feature of DH in 67.29% buffaloes (Deshpande *et al*., 1981; Saini *et al*., 2001) or history of one-time bloat in 7.41% (Athar *et al*., 2010) and un-noticeable bloat in 24.69% bovines. The bloat in DH buffaloes is mostly frothy, as the ruminal air mixes with the rumen feed and this continuous churning of air in the rumen ingesta leads to frothy bloat. Due to this bloat and the adhered reticulum the rumen motility of DH affected bovines was mostly hyper (74.69%) (Athar *et al*., 2010) with dull in few (15.43%) and absent in others (9.88%). The hyper-motility of the rumen is also related to the bloat and such bovines usually regurgitate if do not find an escape to gas or suffer high environmental temperature leading to rise in the temperature of rumen liquor and ultimately regurgitation. In the present study, 8 bovines (4.94%) were presented with the history of regurgitation. Bovines with bloat should not be allowed to travel in high environmental temperatures or should not be fed more at one time, which may lead to regurgitation and thus poor prognosis for surgery.

The bovines suffering from DH were mostly presented with the history of hard black and scanty faeces or sometimes the owner may say no faeces, but on thorough investigation, it comes out to be passing hard black faeces after 2 to 3 days. In the present study, 85.80% of bovines had the history of hard black scanty faeces. The presence of abomasal ulcers has been reported to be the reason for dark coloured faeces in DH bovines (Deshpande *et al*., 1982). A few bovines had a history of loose black faeces (8.64%), and a few had normal faecal output (5.56%). Few bovines had the history of earlier scanty hard faeces which later turned to lose faeces or vice-versa.

Most of the bovines (96.30%) suffering from DH had the history of in-appetence, i.e. the bovines were taking small amount of feed and water. Only 6 buffaloes (3.70%) were presented with complete anorexia.

The respiratory signs are rarely reported in buffaloes suffering from DH, though it is a common finding in dogs with DH. Occasional coughing (9.87%) was recorded when the

herniation was large, or lungs were affected due to drenching or presence of potential foreign body out in the lungs. Respiratory distress (5.55%) with open mouth breathing was rarely recorded until the bovine had regurgitated or the haemoglobin was quite low. Eight bovines of the present study also showed mild brisket oedema (4.94%), which could be associated with the pressure of reticulum on the caudal vena cava or heart (Sangwan *et al*., 2015) due to larger filled herniation or some penetrating foreign body has crossed the herniated reticulum and is touching the pericardium or has pierced into the heart leading to mild pericarditis or may be due to fluid in the chest due to secondary pneumonia.

Usually, the aetiology for DH in buffaloes is reported to be associated with advanced pregnancy or recent parturition with the pressure of the foetus allowing the foreign body in the reticulum to pierce the diaphragm and thus leading to the occurrence of DH (Dhablania *et al*., 1971). But, in the present study, 40.74% of bovines presented were non-pregnant and 59.26% were in some stage of pregnancy. Among non-pregnant 28.79% were recently parturiated which was within one month of presentation. Among pregnant bovines, only 38.64% were in the third trimester of pregnancy (>6 months) and another 20.83% were early pregnant (≤3 months). If calculated overall, 37 bovines were in the third trimester of pregnancy (37/162=22.84%).

Most of the bovines presented were in a period of 8 to 30 days of clinical signs (72.22%) while one bovine was presented after 4 months of clinical signs and one after 1.5 years. Athar *et al*., 2010, also reported the bovines to be presented in a period of 6 days to 4 weeks. Since the signs are mild and keep correcting with mild medicines, the owner did not bother much to get them investigated. Usually, the cows show deterioration in health at a faster rate compared to buffaloes and if presented late are usually very weak and dehydrated with reduced haemoglobin, but in the present study, the operated Sahiwal and a Jersy cross were presented after 30 days of mild clinical signs, while the other Sahiwal was presented within 10 days. Both the male buffalo bulls were presented within 10 days of the appearance of clinical signs.

The average haemoglobin (Hb) in g% was 10.38±2.41 (3.5-17.4) for bovines presented for DH. The maximum number of bovines had Hb between 10 to 12 g% (37.24%) followed by 8 to 10 g% (26.21%). The minimum Hb recorded was 3.5 g% and this bovine was presented recumbent. The 21.38% bovines had Hb >12 g%, which could be due to hemo-concentration due to dehydration. The average TLC count in bovines with DH was 10953.89±3781.02 (1910 to 25620) /cumm. The maximum number of bovines had TLC within the normal reference range (n=98, 67.59%) and 31.72% had increased TLC than the normal reference range. The average neutrophil count was 65.86±15.00% (8-88), which was reversal than normal for neutrophils and lymphocytes. Only 3 bovines had neutrophils within the normal range. Elevated total leucocytes with neutrophilia have been reported as a consistent finding in most of the studies on DH Bovines (Abdelaal *et al*., 2014; Attia, 2016; Ghanshyam *et al*., 2020). One bovine with TLC very low of 1910/cumm, had only 8 neutrophils seen on the slide. The average lymphocytes were 33.12±14.37 (2-74)%, with 21 bovines (21/145=14.48%) having lymphocytes within the normal reference range. The average PCV% was 30.58±6.77 (10.3-46.9), with 52 bovines having PCV within the normal reference range (52/145=35.86%). Most of the bovines had adequate platelet count (82.88%), and 13.01% had increased and 4.11% had decreased platelet count

Table 1. Total no. of month-wise DH presented from Feb 2020 to May 2021.

Month	Buffalo	Cow	(a)	Hospital Occurrence		Radiographic occurrence	
				(b)	(a/b) in %	(c)	(a/c) in %
Feb 2020	20	0	20	433	4.62	98	20.41
Mar 2020	8	0	8	355	2.25	88	9.09
April 2020	Lockdown			167	-	-	-
May 2020	5	0	5	320	1.56	43	11.63
June 2020	14	0	14	550	2.54	101	13.86
July 2020	5	1	6	528	1.14	79	7.59
Aug 2020	9	0	9	612	1.47	59	15.25
Sept 2020	1	0	1	632	0.16	112	0.89
Oct 2020	11	0	11	552	2.0	91	12.08
Nov 2020	6	0	6	394	1.52	68	8.82
Dec 2020	20	1	21	419	5.01	99	21.21
Jan 2021	5	0	5	421	1.19	70	7.14
Feb 2021	16	0	16	464	3.45	116	13.79
Mar 2021	9	1	10	539	1.85	105	9.52
April 2021	17	0	17	476	3.57	132	12.88
May 2021	13	0	13	458	2.84	94	13.83
Total	159	3	162	7300	2.22%	1355	11.96%

{Total bovines presented with DH (a), Total bovines presented to the hospital (b), Hospital Occurrence of DH in % (a/b), Total bovines radiographed for reticulum X-ray (c), Radiographic occurrence of DH in % (a/c)}.

Table 2. Table showing the signalment, history and clinical signs of DH bovines.

Signalment	Range	No of the bovines affected	%
Age in yrs (Figure 2)	Mean ± SD (Range)	5.87±2.21 (2-14 years)	N=162
	≤2 years	1	0.62
	>2-3 years	18	11.11
	>3-5 years	62	38.27
	>5-8 years	65	40.12
	>8 years	16	9.88
Bwt in kgs (Figure 3)	Mean ± SD (Range)	391.39±69.72 (204-560)	N=162
	200-300 Kgs	18	11.11
	301-400 Kgs	70	43.21
	401-500 Kgs	63	38.89
	>500 Kgs	11	6.79
BCS (Figure 4 and 5)	Mean ±SD (Range)	1.69±0.67 (1-3.5)	N=162
	≤1	54	33.33
	>1-2	77	47.53
	>2-3	29	17.90
	>3	2	1.23
HR/min	Mean ± SD (Range)	72.08±16.31(43-120)	
RR/min	Mean ± SD (Range)	22.52±11.31(5-60)	
Temp in °F	Mean ± SD (Range)	100.43±1.88 (95-106)	
General state	alert	133	82.10
	dull	28	17.28
	recumbent	1	0.62
Mucous membrane	pink	96	59.26
	Pale	37	22.84
	congested	29	17.90
Rumen motility	Dull	25	15.43
	Hyper	121	74.69
	Nil	16	9.88
Bloat (Figure 6)	Recurrent	110	67.90
	Once	12	7.41
	Not present	40	24.69
Faeces (Figure 7)	Hard black scanty	139	85.80
	Loose black	14	8.64
	Normal	9	5.56
Anorexia status (Figure 8)	In-appetence	156	96.30
	Complete off-feed	6	3.70

Table 2. Table showing the signalment, history and clinical signs of DH bovines. (Continue)

Signalment	Range	No of the bovines affected	%
Pregnancy status (Figure 9)	Total non-pregnant	66	40.74
	Non-pregnant	47	29.01
	Recent parturited (≤1 month)	19	11.73 (19/66=28.79%)
	Total pregnant	96	59.25
	≤3month pregnancy	20	12.35 (20/96=20.83)
	>3-6 months	39	24.07 (39/96=40.62)
	>6-8 months	18	11.11 (18/96=18.75)
	>8-9 months	12	7.41 (12/96=12.5)
	>9-10 months	7	4.32 (7/96=7.29)
Coughing	Present	16	9.87
	Absent	146	90.12
Respiratory distress	Absent	147	90.74
	Present	9 (2 had BO also)	5.55
	Brisket Odema	8	4.94
Regurgitation	Present	8	4.94
	Absent	154	95.06
Duration of illness	≤ one week	23	14.20
	>7-30 days	117	72.22
	>30-90 days	20	12.34
	>90-365 days	1	0.62
	>365 days	1	0.62
H/o fever	Present	11	6.79
	Absent	151	93.21

Table 3. Table depicting the analysis of haematology values of DH bovines.

Parameters	Reference values adult buffalo	Mean ± SD (Range)	No. of bovines	%
Hb g% (n=145) (Figure 10)	8.9-15.8	10.38±2.41 (3.5-17.4)		
		≤5	3	2.07
		>5-7	8	5.52
		>7-8	11	7.59
		>8-10	38	26.21
		>10-12	54	37.24
		>12	31	21.38
TLC (cumm) (N=145)	5.8-15.5	10953.89±3781.02 (1910-25620)		
		≤8000	27	18.62
		>8000-12000	71	48.97
		>12000	46	31.72
N %	1.36-6.45	65.86±15.00 (8-88)		
L %	2.18-10.5	33.12±14.37 (2-74)		
PCV %	25.3-38.5	30.58±6.77 (10.3-46.9)		
Platelet $X10^3$ (N=146)	131.5- 604.0	adequate	121	82.88
		Inadequate	6	4.11
		Increased	19	13.01

*Reference values taken from Dhillon *et al*., 2020.

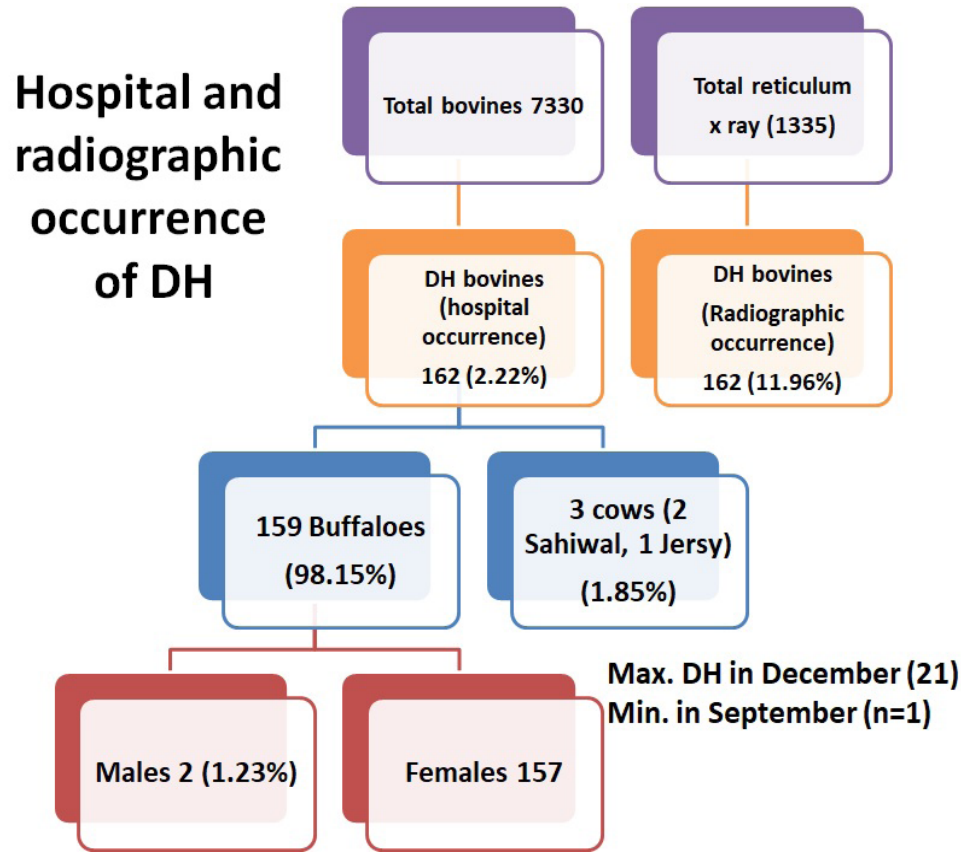

Figure 1. Figure showing the hospital and radiographic occurrence of Diaphragmatic hernia in bovines.

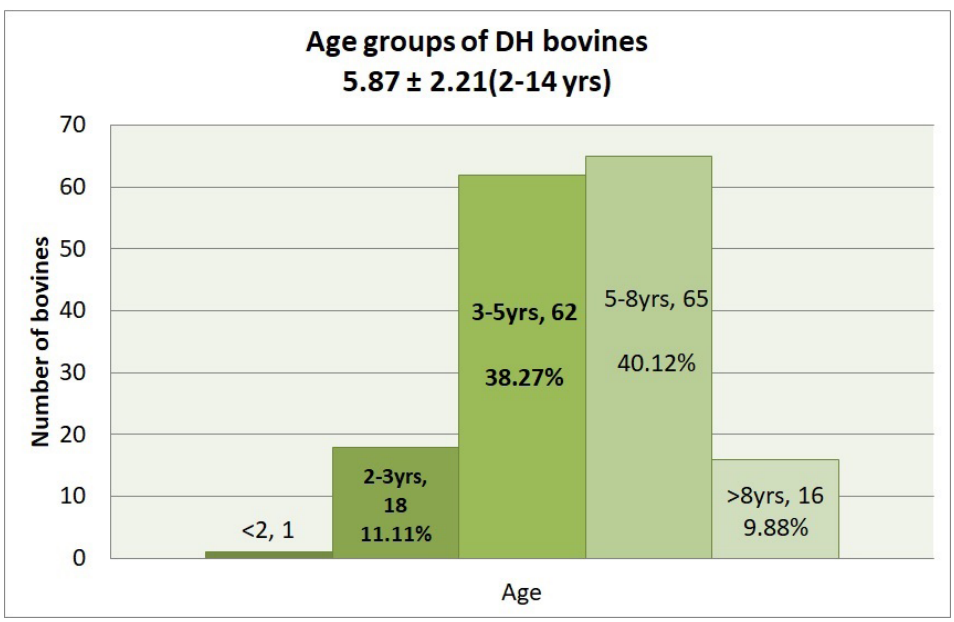

Figure 2. Bar Graph showing the number of bovines in various age groups.

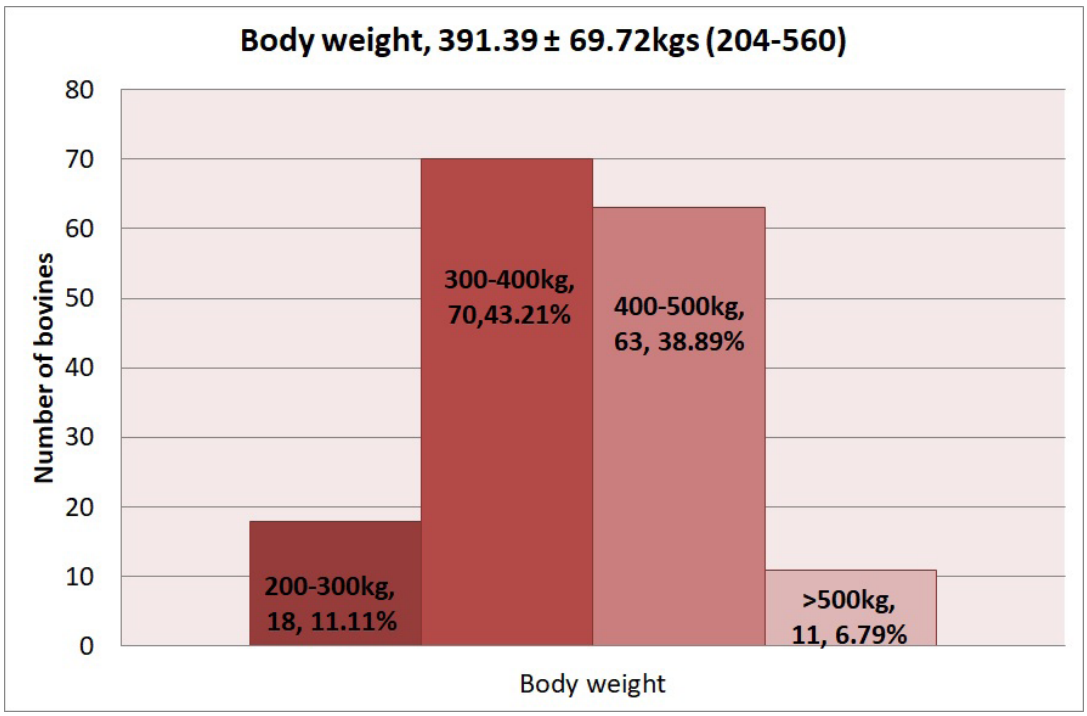

Figure 3. Bar Graph showing the number of bovines in various body weight groups.

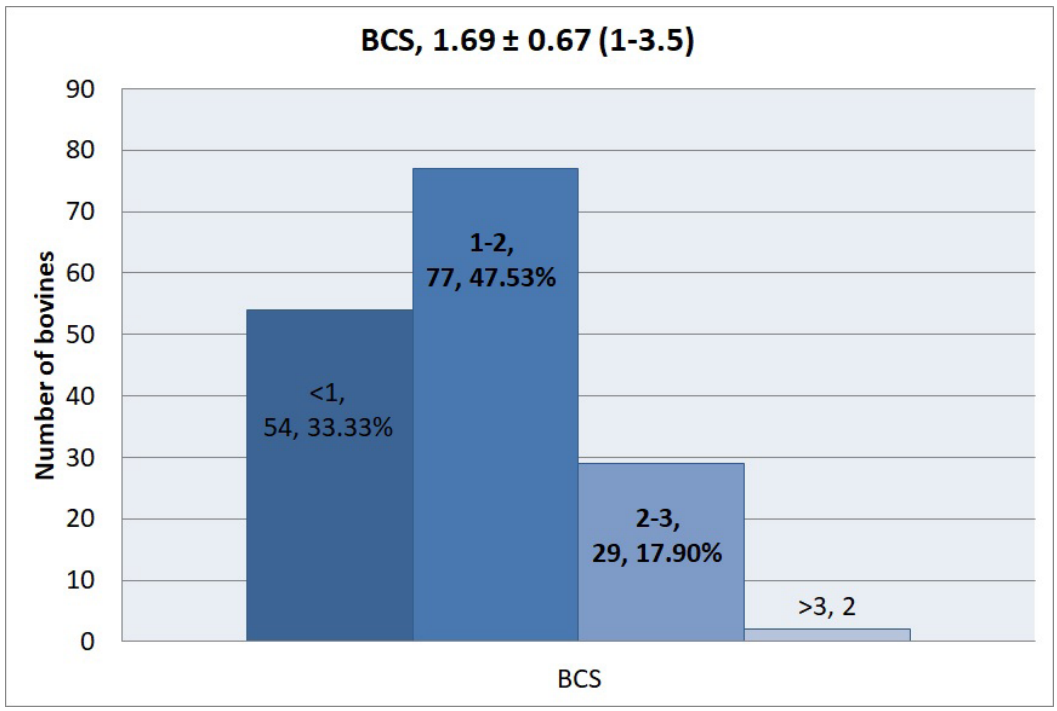

Figure 4. Bar graph showing the number of bovines in various BCS score groups.

Figure 5. Photographs of buffaloes showing various BCS scores.

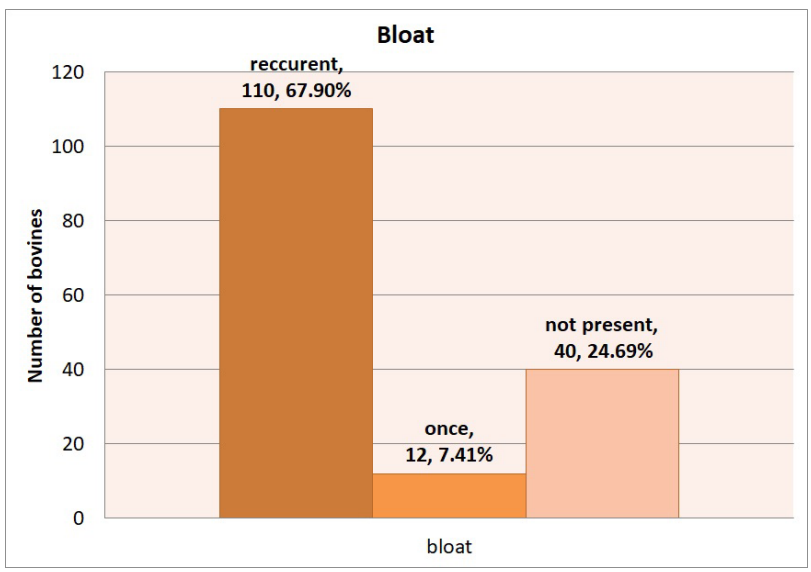

Figure 6. Bar Graph showing number of bovines suffering from bloat.

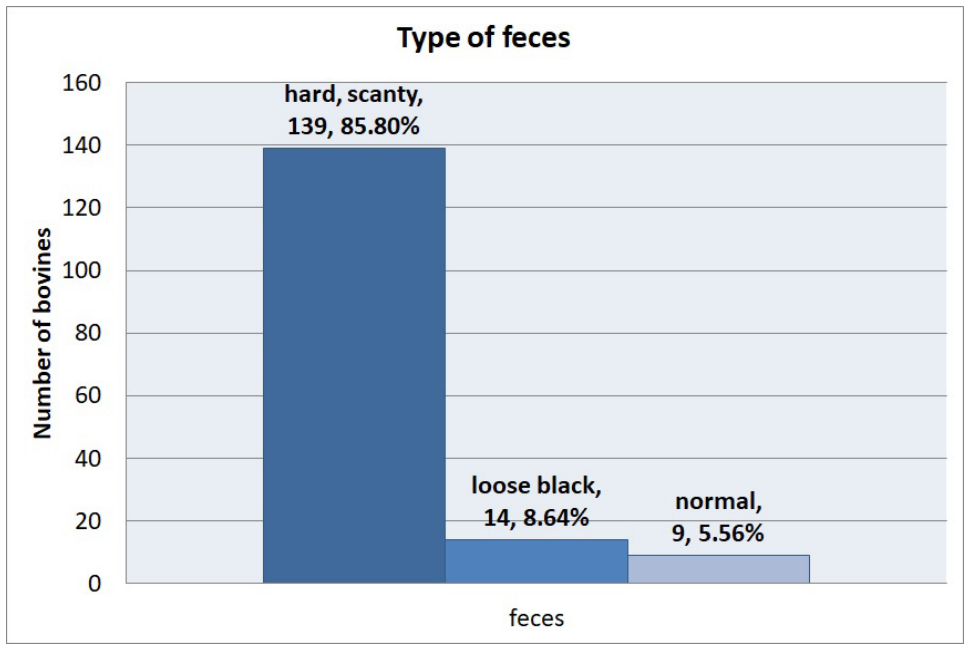

Figure 7. Bar Graph showing the number of bovines with different types of feces.

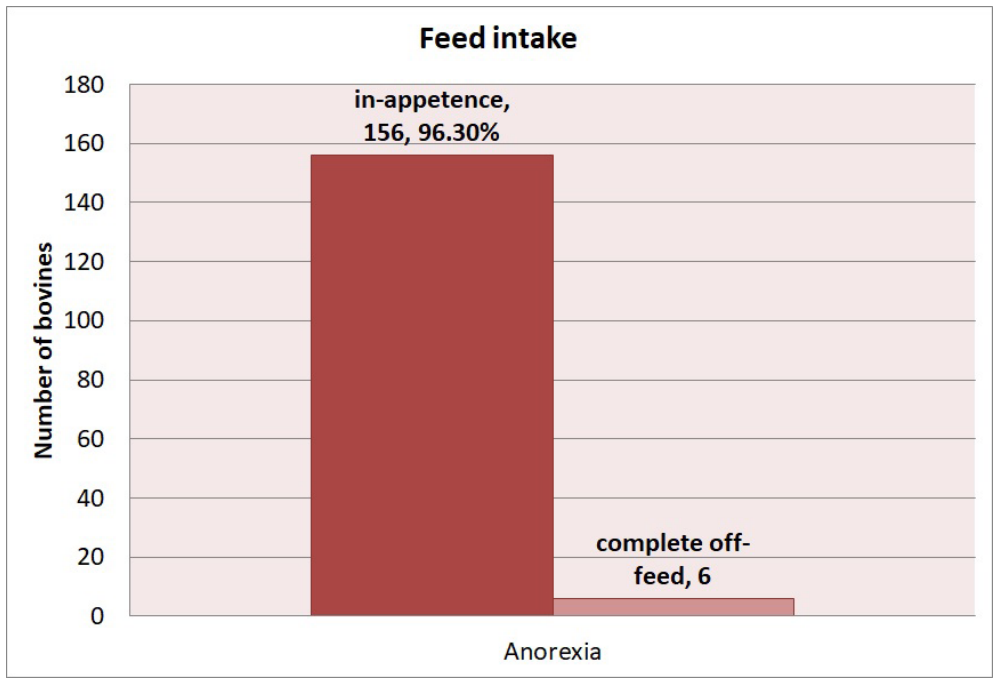

Figure 8. Bar Graph showing the number of bovines with in-appetence or complete anorexia.

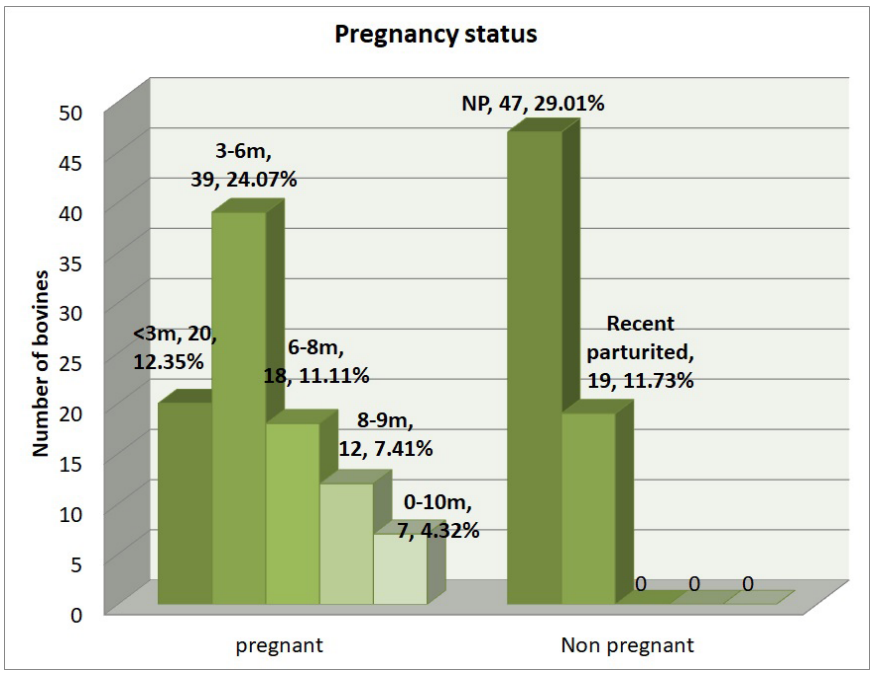

Figure 9, Bar Graph showing the number of bovines in various pregnancy status.

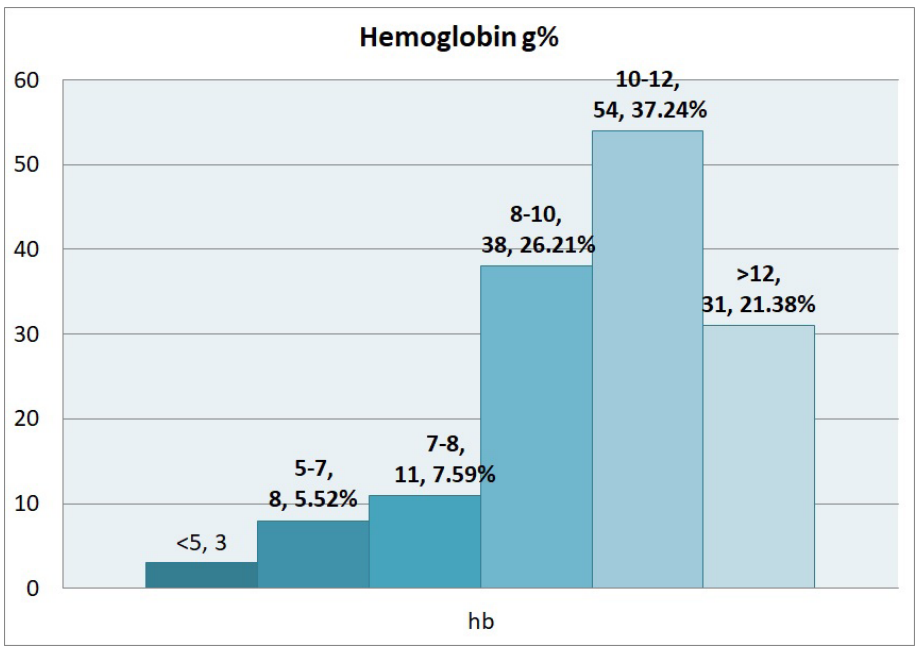

Figure 10. Bar Graph showing the Number of bovines in various hemoglobin groups.

than the normal reference range.

In conclusions

1. The radiographic occurrence of diaphragmatic hernia in buffaloes is alarming; however, the cows and male buffaloes are rarely reported. The existence of DH in indigenous cows is reported.

2. Young adult female buffaloes are maximum susceptible to the disease condition of diaphragmatic hernia.

3. Reduced BCS and body weight was characteristic features of non-pregnant diaphragmatic hernia Bovines.

4. Passage of hard scanty faeces and in-appetence was a characteristic of the condition, however, recurrent bloat, advance pregnancy and presence of potential foreign body on radiograph was not a characteristic feature of diaphragmatic hernia in bovines.

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