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Research Article

A RETROSPECTIVE STUDY ON BOVINE MORTALITY PATTERN IN HARYANA STATE WITH SPECIAL EMPHASIS ON URINARY SYSTEM AFFECTIONS

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ABSTRACT

Ten years (January, 2010 to December, 2019) mortality data on 482 bovine with urinary system lesions studied from the post-mortem reports of bovine i.e. cattle and buffaloes whose carcasses were brought in the Department of Veterinary Pathology for necropsy examination from various Govt. farms/LUVAS farms/Veterinary Clinical Complex/Field cases from Haryana state. Study revealed maximum mortality in adult buffalo and cattle followed by calves (cattle and buffalo) of upto 3 months of age and then of 3-6 months of age. Sex-wise mortality was found to be higher in female adult buffaloes, adult cattle and buffalo calves of upto 3 months of age and 3-6 month age compared to male counterpart of the same age group. In case of cattle calves, mortality was higher in males of upto 3 months of age as compared to female of same age. Whereas, mortality was higher in females of 3-6 month of age as compare to male of same age. Season-wise mortality in cattle and buffalo calves was found to be higher in winter season i.e. 41.52 and 38.83%, respectively while in adult cattle and buffaloes, the highest mortality was observed in rainy season and spring season i.e. 44.16 and 56.00%, respectively. In buffalo and cattle calves, the least mortality was noted in summer and in adult cattle and buffaloes minimal mortality was reported in winter season.

Keywords: Age-wise mortality, Bovine, Month-wise mortality, Retrospective studies, Season-wise mortality, Sex-wise mortality

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The animal husbandry activities in the state and the country as a whole plays a pivotal role in the rural economy through a variety of contributions in the form of income generation, draft power, socio-economic upliftment, employment avenues and better nutrition to human population through livestock products. Cattle and buffalo are key animals in agriculture economy contributing substantially to the gross national products. Dairy animals in Haryana produce 98.09 lacs million tone of milk that accounts for 55.63 % of total milk yield in India (DAH & D, 2013). The buffaloes and cattle are an integral component for improvement of rural economy. The productive, adoptive and multipurpose nature of buffalo has gathered a significant attention in national and international livestock arena for augmenting the milk production in recent years (Ponraj *et al.*, 2017). Pathological conditions of the urinary system in both cattle and buffalo can be the indicators of systemic health. Cham *et al.* (2018) elucidated that there are strong indications that rainfall, minimum temperature, humidity and wind speed variabilities clearly influence the occurrence of reproductive and urinary tract infections in cattle.

MATERIALS AND METHODS

The reason for occurrence of various pathological conditions of the urinary system may be management, infectious agents/diseases and species difference in gross anatomy of the animals. Mortality patterns in bovine serve as a useful indicator for assessing the status of animal health. The knowledge about the occurrence pattern and mortality rate of disease in animals becomes vital in the management and prevention of disease conditions. Keeping in view the above facts, present study was planned to investigate the mortality patterns in bovine of Haryana whose carcasses were brought in the Department of Veterinary Pathology for necropsy examination from various Govt. farms/Lala Lajpat Rai University of Veterinary and Animal Sciences (LUVAS) farms/ Veterinary Clinical Complex/Field cases from Haryana state during the period of past ten years i.e. from January, 2010 to December, 2019. Details regarding species, sex and anatomical location (kidney, ureter, urinary bladder and urethra) were recorded from the clinical history of the cases or post-mortem requisition form. The data was compiled based on the post-mortem reports (both gross- and histopathological lesions especially focus was on the urinary system. Post-mortem records of bovine (both young and adult) showing urinary system lesions were analysed for-A. Sex wise mortality; B. Age-wise mortality; C. Month-wise/Season-wise mortality.

RESULTS AND DISCUSSION

Analyses of data pertaining to the bovine mortality revealed that a total of 1207 bovine carcasses were necropsied (Table 1). Among 1207 bovine cases, 330 were

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of buffalo calf, 413 adult buffalo, 224 of cattle calf and 240 adult cattle. The number of bovine cases in which urinary system lesions were observed was 482 cases including 140, 160, 65 and 117 cases in buffalo calf, adult buffalo, cattle calf and adult cattle, respectively. As per the data the maximum and the minimum mortality in bovine was 151 and 83 in year 2019 and 2011, respectively. Furthermore, major focus on the bovine deaths in which there was urinary system involvement was analyzed and it was observed that maximum cases in which urinary system lesions were observed were in 2013 (70 cases) and minimum in year 2012 (18 cases). More buffalo carcasses (743 cases) were received at the department in comparison to the cattle carcasses (464 cases). Therefore, when a detailed insight was made it was found that adult buffaloes (413 cases) were the one in which maximum post-mortem was conducted at the department subsequently the urinary system involvement was also maximum in case of adult buffaloes (160 cases).

Age-wise distribution of mortality

Out of the targeted factors, age was one of the factor which was studied in detail. The data related to the age wise mortality in buffaloes is presented in table 2. The maximum age-wise mortality was in adult buffaloes (413 cases, 55.58%) followed by buffalo calves of age 0-3 months (211 cases, 28.39%) and least were observed in buffalo calves of age 3-6 months (119 cases, 16.01%). Besides, the data pertaining to the involvement of urinary system lesions showed that maximum cases were in adult buffalo (160 cases, 53.33%) followed by buffalo calves ageing 0-3 months (78 cases, 26.00%) and last standing was of buffalo calves of age 3-6 months (62 cases, 20.67%).

Parallel age-wise studies were also conducted in cattle. The data is presented in table 3. The maximum age-wise mortality in cattle was in adult cattle (240 cases, 51.72%) followed by cattle calves of upto 3 months (185 cases, 39.87%) and the least were in case of cattle calves ageing 3-6 months (39 cases, 8.40%). The urinary system lesions were maximum in adult cattle (117 cases, 64.28%) and minimum in cattle calves of age 3-6 months (9 cases, 4.94%), while cattle calves of age up to 3 months revealed 56 (30.76%) cases with urinary system affections.

Our findings suggest that urinary tract lesions/ infections in adults are more prevalent than in calves, these findings are in corroboration of the findings of Baxter (1989). Whereas, in contrary to this, Yeruham *et al.* (2006) in a survey of herd suggested that urinary tract infections in calves is more prevalent. The reason behind the same may be that the urethra and vulva surface area is more in adults as compared to calves and therefore, the chances of ascending infection to upper urinary tract are more in adults. Higher morbidity of urinary tract infections among adults might be associated with stress during peak production period (Palanivel *et al.*, 2007).

Sex-wise distribution of mortality

Sex-wise distribution of mortality in buffaloes is shown in table 4. In the female buffaloes, mortality was highest in adult female buffaloes (361 cases, 45.58%) followed by buffalo calves of up to 3-month age (110 cases, 14.80%) and buffalo calves of 3-6 months of age (72 cases, 9.69%). Similarly, in the buffaloes in which urinary system lesions were observed, maximum mortality was noticed in adult female buffaloes (138 cases, 46.00%) followed by buffalo calves of up to 3-month age (49 cases, 16.33%) and buffalo calves of 3-6 months of age (39 cases, 13.00%). In the male buffaloes, mortality was highest in males calves of up to 3-month age (101 cases, 13.59%) followed by adult male buffaloes (52 cases, 6.99%) and males of 3-6 month age (47 cases, 6.32%). Similarly, the buffalo in which urinary system lesions were observed, the maximum mortality was highest in males calves of up to 3-month age (29 cases, 9.66%) followed by males of 3-6 months age (23 cases, 7.66%) and adult male buffaloes (22 cases, 7.33%).

Parallel sex-wise mortality studies were also conducted in cattle. The data is presented in table 5. In the female cattle, mortality was highest in adult female cattle (212 cases, 45.69%) followed by cattle calves of up to 3-month age (85 cases, 18.32%) and cattle calves of 3-6 months of age (21 cases, 4.52%). Similarly, the cattle in which urinary system lesions were observed, the maximum mortality was highest in adult female cattle (104 cases, 57.14%) followed by cattle calves of up to 3-month age (26 cases, 14.28%) and cattle calves of 3-6 months of age (7 cases, 3.85%). In the male cattle, mortality was highest in males calves of up to 3-month age (100 cases, 21.55%) followed by adult male cattle (28 cases, 6.03%) and males of 3-6 month age (18 cases, 3.87%). Similarly, the cattle in which urinary system lesions were observed, the maximum mortality was highest in male calves of up to 3-month age (30 cases, 16.48%) followed by adult male cattle (13 cases, 7.14%) and males of 3-6 months age (2 cases, 1.09%).

From the sex wise data, it can be inferred that, females of buffalo and cattle (both young as well as adult) in the present study has shown more urinary tract involvement as compared to males. Explanation behind this is that the vulva may play an important role as the portal of entry of bovine urinary infection. Conditions that lead to damage to mucosa in the lower portion of the urinary tract, such as post-parturient diseases or catheterisation, may predispose the females to urinary tract infection (Markusfeld *et al.*, 1989). Urinary tract infections were more common in female calves than in

Table 1. Total number of post-mortems conducted on different bovine (January, 2010 to December, 2019)

Sr. No.	Year	Total number of post-mortems conducted on bovine				Total number of post-mortem conducted
		Buffalo calf	Adult buffalo	Cattle calf	Adult cattle	
1.	2010	26 (5)	33 (9)	21 (4)	17 (4)	97 (22)
2.	2011	21 (5)	26 (6)	22 (5)	14 (3)	83 (19)
3.	2012	17 (6)	37 (6)	20 (2)	16 (4)	90 (18)
4.	2013	33 (12)	52 (21)	25 (4)	40 (33)	150 (70)
5.	2014	30 (8)	53 (16)	21 (6)	40 (14)	144 (44)
6.	2015	43 (16)	44 (15)	16 (3)	22 (12)	125 (46)
7.	2016	38 (25)	31 (15)	24 (13)	21 (14)	114 (67)
8.	2017	26 (16)	45 (25)	20 (8)	20 (12)	111 (61)
9.	2018	47 (26)	31 (19)	36 (12)	28 (10)	142 (67)
10.	2019	49 (21)	61 (28)	19 (8)	22 (11)	151 (68)
Total number of post-mortems conducted on bovine		330 (140)	413 (160)	224 (65)	240 (117)	1207 (482)
Gross total of buffalo and cattle		743 (300)		464 (182)		

Note: Values in bracket denotes the number and %age of bovine in which urinary system lesions were observed

Table 2. Age-wise distribution of mortality in buffaloes (January, 2010 to December, 2019)

Total number of age wise mortality	Year	Age Groups			Total mortality	% age mortality N=743 (n=300)
		Buffalo calves		Adult buffalo		
		Up to 3 months	3-6 month			
Buffaloes	2010	18 (3)	8 (2)	33 (9)	59 (14)	7.94 (4.67)
	2011	18 (5)	3	26 (6)	47 (11)	6.33 (3.67)
	2012	15 (6)	2	37 (6)	54 (12)	7.26 (4.00)
	2013	22 (7)	11 (5)	52 (21)	85 (33)	11.44 (11.00)
	2014	16 (4)	14 (4)	53 (16)	83 (24)	11.17 (8.00)
	2015	25 (10)	18 (6)	44 (15)	87 (31)	11.71 (10.33)
	2016	18 (11)	20 (14)	31 (15)	69 (40)	9.28 (13.33)
	2017	9 (4)	17 (12)	45 (25)	71 (41)	9.56 (13.67)
	2018	32 (16)	15 (10)	31 (19)	78 (45)	10.49 (15.00)
	2019	38 (12)	11 (9)	61 (28)	110 (49)	14.80 (16.33)
Total		211 (78)	119 (62)	413 (160)	743 (300)	-
%age N=743 (n=300)		28.39 (26.00)	16.01 (20.67)	55.58 (53.33)	100.00 (100.00)	-

Note: Values in bracket denotes the number and %age of buffalo in which urinary system lesions were observed

Table 3. Age-wise distribution of mortality in cattle (January, 2010 to December, 2019)

Total number of age wise mortality	Year	Age Groups			Total mortality	% age mortality N=464 (n=182)
		Cattle calves		Adult cattle		
		up to 3 months	3-6 month			
Cattle	2010	18 (3)	3 (1)	17 (4)	38 (8)	8.19 (4.39)
	2011	20 (5)	2	14 (3)	36 (8)	7.75 (4.39)
	2012	16 (2)	4	16 (4)	36 (6)	7.75 (3.29)
	2013	22 (4)	3	40 (33)	65 (37)	14.01 (20.32)
	2014	17 (5)	4 (1)	40 (14)	61 (20)	13.15 (10.98)
	2015	10 (2)	6 (1)	22 (12)	38 (15)	8.18 (8.24)
	2016	21 (12)	3 (1)	21 (14)	45 (27)	9.69 (14.84)
	2017	15 (8)	5	20 (12)	40 (20)	8.62 (10.98)
	2018	30 (9)	6 (3)	28 (10)	64 (22)	13.79 (12.09)
	2019	16 (6)	3 (2)	22 (11)	41 (19)	8.84 (10.43)
Total		185 (56)	39 (9)	240 (117)	464 (182)	-
%age N=464 (n=182)		39.87 (30.76)	8.40 (4.94)	51.72 (64.28)	100.00 (100.00)	-

Note: Values in bracket denotes the number and %age of cattle in which urinary system lesions were observed

Table 4. Sex-wise distribution of mortality in buffaloes (January, 2010 to December, 2019)

Total number of sex wise mortality	Year	Age Groups						Total mortality	% age mortality N=743 (n=300)
		Buffalo calves				Adult cattle			
		Male		Female		Male	Female		
		upto 3 month	3-6 month	upto 3 month	3-6 month				
Buffalo	2010	12 (2)	4 (1)	6 (1)	4 (1)	6 (3)	27 (6)	59 (14)	7.94 (4.67)
	2011	8 (2)	2	10 (3)	1	5 (3)	21 (3)	47 (11)	6.33 (3.67)
	2012	6 (2)	2	9 (4)	-	4	33 (6)	54 (12)	7.27 (4.00)
	2013	10 (1)	4 (1)	12 (6)	7 (4)	3 (2)	49 (19)	85 (33)	11.44 (11.00)
	2014	11 (3)	5 (1)	5 (1)	9 (3)	8 (2)	45 (14)	83 (24)	11.17 (8.00)
	2015	6 (2)	3 (1)	19 (8)	15 (5)	4 (2)	40 (13)	87 (31)	11.71 (10.33)
	2016	9 (5)	10 (6)	9 (6)	10 (8)	4 (1)	27 (14)	69 (40)	9.29 (13.33)
	2017	6 (3)	9 (6)	3 (1)	8 (6)	6 (3)	39 (22)	71 (41)	9.56 (13.67)
	2018	15 (5)	5 (4)	17 (11)	10 (6)	5 (3)	26 (16)	78 (45)	10.49 (15.00)
	2019	18 (4)	3 (3)	20 (8)	8 (6)	7 (3)	54 (25)	110 (49)	14.80 (16.33)
Total		101 (29)	47 (23)	110 (49)	72 (39)	52 (22)	361 (138)	743 (300)	-
%age N= 743 (n=300)		13.59 (9.66)	6.32 (7.66)	14.80 (16.33)	9.69 (13.00)	6.99 (7.33)	45.58 (46.00)	100.00 (100.00)	-

Note: Values in bracket denotes the number and %age of buffaloes in which urinary system lesions were observed

Table 5. Sex-wise distribution of mortality in cattle (January, 2010 to December, 2019)

Total number of sex wise mortality	Year	Age Groups						Total mortality	% age mortality N=464 (n=182)
		Cattle calves				Adult cattle			
		Male		Female		Male	Female		
		upto 3 month	3-6 month	upto 3 month	3-6 month	above 6 months	above 6 months		
Cattle	2010	11 (1)	1	7 (2)	2 (1)	2 (2)	15 (2)	38 (8)	8.19 (4.39)
	2011	13 (3)	2	7 (2)	-	3	11 (3)	36 (8)	7.76 (4.39)
	2012	5	1	11 (2)	3	4 (1)	12 (3)	36 (6)	7.76 (3.29)
	2013	11 (2)	1	11 (2)	2	2 (2)	38 (31)	65 (37)	14.01 (20.33)
	2014	8 (1)	1	9 (4)	3 (1)	5 (2)	35 (12)	61 (20)	13.14 (10.99)
	2015	5 (1)	4	5 (1)	2 (1)	3 (2)	19 (10)	38 (15)	8.19 (8.24)
	2016	13 (8)	2	8 (4)	1 (1)	1	20 (14)	45 (27)	9.69 (14.84)
	2017	7 (4)	2	8 (4)	3	3 (2)	17 (10)	40 (20)	8.62 (10.99)
	2018	17 (5)	2 (1)	13 (4)	4 (2)	3 (1)	25 (9)	64 (22)	13.79 (12.08)
	2019	10 (5)	2 (1)	6 (1)	1 (1)	2 (1)	20 (10)	41 (19)	8.84 (10.44)
Total		100 (30)	18 (2)	85 (26)	21 (7)	28 (13)	212 (104)	464 (182)	-
%age N=464 (n=182)		21.55 (16.48)	3.87 (1.09)	18.32 (14.28)	4.52 (3.85)	6.03 (7.14)	45.69 (57.14)	100.00 (100.00)	-

Note: Values in bracket denotes the number and %age of cattle in which urinary system lesions were observed

males (0.7%), perhaps because of the shorter urethra in females (Yeruham *et al.*, 2004). Urinary tract infection has been recorded as a common sequel to retention of the afterbirth, metritis and vaginitis (Markusfeld *et al.*, 1989). These conditions may predispose the cow to urinary tract infection as a result of various bacterial infections ascending from the lower urinary tract to the urinary bladder and via the ureters to the kidneys (Markusfeld *et al.*, 1989).

Month-wise and season-wise distribution of mortality

A sincere effort was made to check season-wise reporting of mortality for the period from January, 2010 to December, 2019 in both buffaloes and cattle. The data is presented in table 6 for buffaloes. The whole year was divided into four seasons i.e. winter (December, January and February), spring (March, October and November), summer (April, May and June) and rainy season (July, August and September). Furthermore, the data was analyzed in two categories i.e. calves and adults. Table 6 shows that the maximum mortality of buffalo calves was in winter season (107 cases 32.42%) followed by rainy season (88 cases, 26.66%) and spring season (74 cases, 22.42%)

Table 6. Month-wise and season-wise distribution of mortality in buffaloes (January, 2010 to December, 2019)

Species	Year	Dec.	Jan.	Feb.	March	Oct	Nov	April	May	June	July	Aug.	Sept.
Seasons		Winter season			Spring Season			Summer season			Rainy season		
Buffalo calf	2010	-	2	3 (2)	2	5 (1)	2	3	2	2	-	2 (1)	3 (1)
	2011	2	7 (3)	2	-	5 (2)	1	1	1	-	-	-	2
	2012	1* (1)	-	3 (2)	-	1 (1)	4 (2)	-	1	1	1	2	3
	2013	4 (1)	4 (1)	5 (3)	6 (2)	6 (2)	1	3 (1)	1 (1)	1	-	-	2 (1)
	2014	1	7 (1)	4 (2)	1	2	1 (1)	3 (1)	1	2 (1)	1	3* (1)	4 (1)
	2015	-	9 (3)	3	-	-	2 (2)	4 (1)	4	3 (2)	7 (4)	4 (1)	7 (3)
	2016	7 (4)	5 (2)	3 (3)	1 (1)	2 (2)	4 (2)	4 (2)	3* (3)	2 (1)	1 (1)	2 (1)	4 *(3)
	2017	1 (1)	3 (2)	4 (2)	1 (1)	1 (1)	2 (2)	3 (2)	4 (4)	1	2	2 (1)	2
	2018	1 (1)	8 (5)	3 (1)	1	6 (4)	11 (2)	1* (1)	2 (1)	-	-	9* (7)	5 (4)
	2019	11 (4)	3 (2)	1	1 (1)	3 (2)	2 (1)	4 (2)	2 (1)	2 (2)	2	7 (3)	11 (3)
Total number of month-wise mortality		28 (12)	48 (19)	31 (15)	13 (5)	31 (15)	30 (12)	26 (10)	21 (10)	14 (6)	14 (5)	31 (15)	43 (16)
%age of month-wise mortality N=330 (n=140)		8.48 (8.57)	14.55 (13.57)	9.39 (10.71)	3.93 (3.57)	9.39 (10.71)	9.09 (8.57)	7.88 (7.14)	6.36 (7.14)	4.24 (4.28)	4.24 (3.57)	9.39 (10.71)	13.03 (11.43)
Total number of season-wise mortality			107(46)			74(32)			61(26)			88(36)	
%age of season-wise mortality			32.42(32.85)			22.42 (22.86)			18.48 (18.57)			26.66 (25.71)	
Adult buffalo	2010	3	1	3	4 (2)	-	5 (2)	2 (2)	2	4	2	6 (2)	1 (1)
	2011	3 (1)	4 (1)	1	2 (1)	2 (1)	2	-	-	4 (1)	2	5 (1)	1
	2012	3 (1)	1	6 (1)	2 (1)	4	4 (2)	2 (1)	1	2	8	2	2
	2013	4 (2)	2 (2)	4 (1)	3 (2)	13 (8)	12 (3)	3 (2)	2	2	1	1	5 (1)
	2014	3	2	7 (1)	4 (1)	3	6	3 (1)	7 (2)	7 (6)	5 (1)	5 (4)	1
	2015	3 (1)	1	3 (1)	1	2 (1)	2 (1)	6 (1)	4 (3)	11 (2)	4 (2)	1	6 (3)
	2016	-	-	2 (1)	1	2	4 (1)	3 (2)	4 (3)	2 (2)	1 (1)	10 (3)	2 (2)
	2017	3 (2)	5 (3)	1 (1)	4 (4)	1* (1)	5 (2)	5 (3)	5 (3)	4	2	3 (3)	7* (3)
	2018	1	5* (3)	-	3 (2)	5 (4)	1	2 (2)	3* (3)	3 (1)	3 (2)	3	2 (2)
	2019	2	3 (1)	5 (2)	3 (2)	9 (3)	10 (8)	3 (2)	7 (1)	3 (2)	4	5 (3)	7 (4)
Total number of month-wise mortality		25(7)	24(10)	32(8)	27 (15)	41(18)	51(19)	29 (16)	35(15)	42(14)	32(6)	41(16)	34(16)
%age of month-wise mortality N=413 (n=160)		6.05 (4.38)	5.81 (6.25)	7.75 (5.00)	6.54 (9.38)	9.93 (11.25)	12.35 (11.87)	7.02 (10.00)	8.47 (9.38)	10.17 (8.75)	7.75 (3.75)	9.93 (10.00)	8.23 (10.00)
Total number of season-wise mortality			81 (25)			119 (52)			106 (45)			107 (38)	
%age of season-wise mortality			19.61(15.62)			28.81(32.5)			25.66 (28.12)			25.90 (23.75)	

Note: Values in bracket denotes the number and %age of buffalo in which urinary system lesions were observed

while the least was reported in summer season (61 cases, 18.48%). Whereas, the buffalo calves in which urinary system lesions were observed revealed highest mortality again in winter season (46 cases, 32.85%) followed by rainy season (36 cases, 25.71%), spring season (32 cases, 22.86%) and minimum in summer season (26 cases, 18.57%).When the season-wise mortality trend in adult buffaloes was analyzed, the maximum mortality was observed in spring season (119 cases, 28.81%), subsequently in rainy season (107 cases, 25.90%), summer season (106 cases, 25.66%) and least in winter season (81 cases, 19.61%). Whereas, in the adult buffaloes with urinary system lesions, the highest mortality was observed in spring season (52 cases, 32.50%) subsequently in summer season (45 cases, 28.12%), followed by rainy season (38 cases, 23.75%) and minimum in winter season (25 cases, 15.62%).

On similar pattern the month and season-wise mortality data of cattle calves and adult cattle was analyzed (Table 7). It is hereby elucidated that, the maximum mortality in cattle calves was reported in spring season (65 cases, 29.01%) and the minimum mortality was in summer season (44 cases, 19.64%). The winter season reported 54 cases (24.10%) and the rainy season had received 61 cases (27.23%). Whereas, the cattle calves in which urinary system lesions were observed revealed highest mortality in winter season (21 cases, 32.30%) followed equally by rainy and spring season (18 cases in each season, 26.15%) and the minimum cases were reported in summer season (10 cases, 15.38%).

Month and season wise data of adult cattle revealed maximum deaths in rainy season (86, 35.83%), followed

Table 7. Month-wise and season-wise distribution of mortality in cattle (January, 2010 to December, 2019)

Species	Year	Dec.	Jan.	Feb.	March	Oct	Nov	April	May	June	July	Aug.	Sept.
Seasons		Winter season			Spring Season			Summer season			Rainy season		
Cattle calf	2010	1	2	-	6	2 (1)	2	3 (2)	2	-	-	2 (1)	1
	2011	1	3 (1)	-	-	5 (3)	3	-	1	3 (1)	2	1	3
	2012	1	3	1 (1)	1	4	1	1	3	-	-	3 (1)	1
	2013	4 (1)	-	-	3 (1)	3 (1)	3	2	1	-	-	4	4 (1)
	2014	1 (1)	1	3	2 (1)	-	2	1 (1)	-	5 (2)	2 (1)	2	2
	2015	-	3 (1)	1	1	1	2	4 (2)	-	-	-	2	2
	2016	3 (2)	-	4	2 (2)	4 (2)	1 (1)	-	-	-	6 (5)	1 (1)	5
	2017	1	3 (3)	3 (2)	1 (1)	1	2 (2)	-	1	2	3	3	-
	2018	-	3 (2)	3 (1)	2	6	2 (1)	3	3 (1)	5	1	6 (5)	2 (2)
	2019	3 (1)	4 (3)	2 (2)	-	-	3 (1)	3 (1)	1	-	-	3	-
Total number of month-wise mortality		15 (5)	22 (10)	17 (6)	18 (5)	26 (7)	21 (5)	17 (6)	12 (1)	15 (3)	14 (6)	27 (8)	20 (3)
%age of month-wise mortality N=224 (n=65)		6.69 (7.69)	9.82 (15.38)	7.58 (9.23)	8.03 (7.69)	11.60 (10.76)	9.37 (7.69)	7.58 (9.23)	5.36 (1.53)	6.69 (4.61)	6.25 (9.23)	12.05 (12.30)	8.92 (4.61)
Total number of season-wise mortality		54 (21)			65 (17)			44 (10)			61 (17)		
%age of season-wise mortality		24.10 (32.30)			29.01 (26.15)			19.64 (15.38)			27.23 (26.15)		
Adult cattle	2010	2	-	2	1	1	1	2 (1)	4 (1)	1	-	2 (1)	2 (1)
	2011	2 (2)	-	1	-	-	-	2	2	2	3 (1)	2	-
	2012	-	-	3	-	2 (1)	5 (1)	2 (1)	1 (1)	-	1	1	1
	2013	-	2 (2)	1	-	2 (1)	2 (1)	1 (1)	-	2	22 (22)	1	7 (6)
	2014	6 (1)	1 (1)	2	1 (1)	3 (1)	3 (1)	-	2 (1)	2	2	9 (5)	8 (3)
	2015	1 (1)	3 (2)	-	1 (1)	4 (1)	2	1 (1)	-	3	2 (2)	3 (3)	2 (1)
	2016	2 (2)	2	1	5 (1)	1 (1)	2 (2)	3 (2)	2 (2)	1 (1)	1	3 (3)	-
	2017	1 (1)	3 (1)	-	2 (2)	1	3 (2)	-	1 (1)	5 (2)	1 (1)	2 (2)	1
	2018	-	3 (1)	3 (1)	1 (1)	3 (1)	3	4 (2)	3	2 (2)	1 (1)	1 (1)	4
	2019	2 (1)	5 (2)	4 (1)	-	3 (2)	-	1 (1)	-	1 (1)	1 (1)	2 (1)	1
Total number of month-wise mortality		16 (8)	19 (9)	17 (2)	11 (6)	20 (8)	21 (7)	16 (9)	15 (6)	19 (6)	34 (28)	26 (17)	26 (11)
%age of month-wise mortality N=240 (n=117)		6.66 (6.83)	7.72 (7.69)	7.08 (1.70)	4.58 (5.12)	8.33 (6.83)	8.75 (5.98)	6.66 (7.69)	6.25 (5.12)	7.91 (5.12)	14.16 (23.93)	10.83 (14.52)	10.83 (9.40)
Total number of season-wise mortality		52 (19)			52 (21)			50 (21)			86 (56)		
%age of season-wise mortality		21.66 (16.23)			21.66 (17.94)			20.83 (17.94)			35.83 (47.86)		

Note: Values in bracket denotes the number and %age of cattle in which urinary system lesions were observed, *denotes death because of urinary system failure

equally by summer and spring season (52 cases in each season, 21.66%). The least mortality was observed in summer season with total reported cases as 50 (20.83%). However, in the adult cattle with urinary system lesions, the highest mortality was observed in rainy season (56 cases, 47.86%) followed equally by spring and summer season (21 cases in each season, 17.94%) and the least were reported in winter season (19 cases, 16.23%).

The probable reason for increased cases of urinary system involvement in buffalo calves and cattle calves during winter season might be due to unhygienic condition of shed and improper protection from chilled weather. The other explanation may be that during the winter, the number of daylight hours and amount of sunshine that human are exposed to decreases greatly. The shorter day's lead to less production of vitamin D (Dowell, 2001; Sloan *et al.*, 2011). This leads to reduced immune function and increases the risk of infection, a finding supported by animal and observational studies (Dowell, 2001). In winter months cattle or buffaloes usually drink less water that makes them dehydrated thereby making them more prone to urinary tract infections and the same is supported by the

findings of Gray and Krissovich (2003). They found that increased fluid intake and hydration monitoring with an osmolality probe in human outpatients (Eckford *et al.*, 1995) is associated with reduced risk of urinary tract infections. Seasonality, or the cycle of low and high incidence, of infectious diseases has long been recognized. The earliest works of epidemiology dating back to Hippocrates discuss the changing of disease with the changing of the seasons. Despite the number of seasonal diseases and the cumulative importance of these pathogens, the causes are poorly understood (Simmering, 2016). Cham *et al.* (2018) elucidated that there are strong indications that rainfall, minimum temperature, humidity and wind speed variabilities clearly influence the occurrence of reproductive and urinary tract infections in cattle. However, in the adult cattle with urinary system lesions the highest mortality was observed in rainy season (56 cases, 47.86%) followed equally by spring and summer season (21 cases in each season, 17.94%) and the least were reported in winter season (19 cases, 16.23%). Urologists say, one of the most common infections that may increase during monsoon season is urinary tract infection (Skymet Weather Team, 2013). They reported that unseasonable types of weather, that is, cold and dry weather in autumn, warm and rainy weather in winter, and warm and dry weather in spring, were accompanied by a clear increase in the monthly number of episodes of urinary tract infections. The difference in the monthly frequency of urinary tract infections between the most and the least favourable types of weather was about two-fold. This is primarily due to sudden changes in temperature which causes the immunity to decrease and increase the susceptibility to catch infections. Also, many organisms such as bacteria flourish lavishly owing to hot and humid conditions. The same explanation might be associated with the specific season-wise increased occurrence of urinary tract infections amongst bovine in the present retrospective study.

CONCLUSION

In conclusion, the findings of the present retrospective study have provided preliminary baseline data on bovine mortality involving urinary system lesions in bovine of different ages, sex and season in Haryana, India. Despite the inclusion of an extensive post mortem studies focusing on various aspects, in only 39.93% of cases mortality was because of US involvement and underlying infectious causes could be identified. Thus, this detailed retrospective study could help in designing research projects focussing on bovine mortalities involving US lesions of different age, sex and season.

CONFLICT OF INTEREST: Author(s) declares that there is no conflict of interest regarding this article.

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