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RESEARCH OPINIONS IN ANIMAL & VETERINARY SCIENCES

Epidemiological evaluation of clinical bovine respiratory disease complex in a tropical Mexican feedlot

José Alfredo Villagómez-Cortés[1*] and David Itzcoatl Martínez-Herrera[1]

[1]Facultad de Medicina Veterinaria y Zootecnia, Universidad Veracruzana. Circunvalación y Yañez, Col. Unidad Veracruzana, 91710, Veracruz, Veracruz, México

Abstract

The aim of this study was to epidemiologically characterize the appearance of clinical bovine respiratory disease complex (BRDC) in a Mexican feedlot. A retrospective study on 260211 records registered over a year and collected from animals housed in 210 pens was performed. In the study period, a total of 67467 steers were housed, with an incoming monthly average of 5190 ± 1252. There were 12783 BRDC clinical cases (18.9% of total steers), representing between 84.5 and 99.9% of all disease cases identified monthly in the pens (95.18 ± 5.10% sick animals per month). Other conditions requiring animal medication were lameness, diarrhea, and balanoposthitis. The average weight at BRDC first treatment was 335.71 ± 9.78 kg, but sick animals lost 15 kg. in average between the weight on arrival and the weight at first treatment. Average rectal temperature in animals affected by BRCD was 39.34 ± 0.94^{0}C and 39.23 ± 0.67^{0}C in relapsed steers. During the studied period 400 animals died (0.15% of the total), but only 105 died from BRCD (0.04% of the total). Overall monthly BRDC deaths represented 26.5% of total deaths, but the proportion of monthly deaths due to BRDC to the total number of deaths ranged between 0.22% and 48.1%, with higher values between July and September, 2010. BRDC lethality rate had an average value of 0.82% during the period, ranging monthly between 0.17 and 2.21 %. The average success of a first treatment against BRDC was 92.4%. Average monthly relapsed animals were 67 ± 41.3, ranging between 31 and 172 cases in April and February, respectively. Almost twice the number of sick animals was observed in winter (34%) than in fall, which had the lowest proportion of cases (18.1%); spring (22.4%) and summer (25.5%) had intermediate levels. The feedlot had only five animal suppliers, but most steers came from southern Veracruz (54.6%, 35190/67467). The percentage of BRDC sick animals by provenance of origin ranged from 3.68% (Tuxtepec, Oaxaca) to 19.15% (Chiapas). According to provenance, the number of relapsed animals ranged from one (Tuxtepec, Oaxaca) to 493 (south of Veracruz), but animals from more distant places (Tabasco and Chiapas), exhibited the highest value (between 7.65 and 7.85%). The heaviest and the lightest steers were more prone to BRDC relapse than animals in an average weight. Only 11 animals required a third treatment, five of which were treated in February. In conclusion, most susceptible steers to BRDC illness were those transported over larger distances, those which arrive in winter, as well as the heaviest and the lightest.

Keywords: Beef cattle; bovine respiratory disease complex; clinical disease; humid tropic; Latin America; retrospective study

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Introduction

Respiratory diseases in bovine cattle caused by bovine respiratory disease complex (BRDC) have been established as economically important diseases to the cattle industry worldwide, but notably to feedlot cattle (Schneider et al., 2009; Urban – Chmiel and Grooms, 2012.). The development of BRDC is multifactorial,

Corresponding author: José Alfredo Villagómez-Cortés, Facultad de Medicina Veterinaria y Zootecnia, Universidad Veracruzana. Circunvalación y Yañez, Col. Unidad Veracruzana, 91710, Veracruz, Veracruz, México

including a stress situation and the presence of various germs. The etiology of pneumonia can be quite varied, i.e. Bovine adenoviruses (BAV), Bovine herpesvirus 1 (BHV-1), Bovine respiratory syncytial virus (BRSV), Bovine viral diarrhoea virus (BVDV), Bovine parainfluenza virus 3 (PI-3), *Mannheimia haemolytica*, *Pasteurella multocida*, and *Histophilus somni* (formerly *Haemophilus somnus*) (Yates, 1982; Martin et al., 1988; Binkhorst et al., 1990). However, stressful events are the primary factors contributing to BRDC and may include environmental, nutritional, and management stressors such as, prolonged transport, commingling, overcrowding, mixing of animals of different ages and immunological status, heat or cold, dust, weaning, high humidity, poor ventilation facilities, irregular feeding schedules, and sudden ration changes (Loneragan et al., 2001; Sanderson et al., 2008).

BRDC is the most costly beef cattle disease in the United States. Costs associated with its prevention, treatment, morbidity, and mortality have been estimated from $13.90 to $15.57 per head (Snowder et al., 2006). Annual losses to the US cattle industry are estimated to approach $1 billion, whereas preventive and treatment costs are over $3 billion annually (Griffin, 1997). Data presented consistently demonstrated the cost of BRD from weaning to the packers to be approximately 7% of the total production cost when compared to animals with health respiratory tracts.

Even though mortality by BRDC is the aspect that most impresses the beef producers and is of primary interest, the economic losses in chronically affected animals are much more important, because morbidity can cost even more than mortality, considering both direct (weight loss, inefficient feed conversion, premature removal of some animals, cost of reduced performance during and after illness, carcass condemnation and lesser beef production) and the indirect effects of the disease (costs associated with medications, additional management and labor needed for treatment) (Martin et al, 1982; García et al., 2010).

Epidemiological studies on clinical BRDC have received little attention. However, the knowledge of disease and its performance throughout the year can be helpful to take preventive measures and make decisions on how to increase production efficiency in the feedlot. Therefore, the objective of the study reported herein was to analyze the epidemiological performance of Bovine Respiratory Disease Complex in a feedlot located in the humid tropics of Veracruz, Mexico.

Materials and Methods

Location

The study was conducted in the "Dos Matas" feedlot located in Rancho Hidalgo, municipality of Tierra Blanca in Veracruz, Mexico. This commercial productive unit is located at an altitude of 130 meters in a subhumid tropical climate.

Animal management

The feedlot has a capacity for 20000 steers distributed in 210 open-air, dirt-floor, arranged side by side fattening pens. Each pen has a capacity for 65 or 120 animals. There is also a well-equipped hospital facility. On arrival, each animal was identified with an ear tag, received vaccines for viral and bacterial agents (infectious bovine rhinotracheitis virus, bovine viral diarrhea type 1 and type 2), parainfluenza 3 virus, bovine respiratory syncytial virus, *Mannheimia (Pasteurella) haemolytica* type A1, *Clostridium chauvoei*, *Cl. septicum*, *Cl. novyi*, *Cl. sordelli*, and *Cl. perfringens* type B, C and D). At the same time, a trenbolone acetate and oestradiol benzoate based implant, a fasciolicide via intraruminal (triclabenzadole) and a dewormer (doramectin) were applied to each steer. Also, an individual record was opened in the computer database for the collection of animal health and performance data.

Feedlot cattle were composed by varying degrees crosses of *Bos taurus* and *Bos indicus* animals. During their permanence in the pens steers received two diets, a wet diet based on barley and a dry diet based on corn. Average daily weight gain per animal during the study period was 1.850 Kg.

Disease identification and management

During the first days after arrival, animals are kept in close observation. A veterinarian checks the animals every day and implements and monitors the treatment of those who become ill. Treatment can take place in the pen or in the hospital. The hospital has facilities and equipment that allow better serve sick animals. Animals that show a disease clinically compatible with BRDC receive immediate treatment based on florfenicol-flunixin meglumine and/or tulathromycin, at the doses recommended by the manufacturers, as prescribed in a written treatment protocol. According to empirical experience, most cases that receive a first treatment occur within the first three weeks after animal arrival, peaking around 7 days. In animals that require a second treatment, the time between the first and the second treatment range between 5 and 10 days after the first treatment.

Study design and population

A retrospective longitudinal study was conducted on records collected from 210 pens between October 2009 and October 2010, based on the recommendations by Corbin and Griffin (2006). Several variables in different categories were considered for this study:

***Variables collected on steers arrival*:** Date of arrival; size of the animal: minimum (less than 300 kg), small

(less than 330 kg), medium (331-360 kg), large (361-390 kg) or extra (over 391 kg); provenance: South of the state of Veracruz, Chiapas, northern of the states of Tabasco and Chiapas, Tabasco, and Tuxtepec, Oaxaca; individual weight on arrival (kg), age at arrival (months), and rectal temperature on arrival (C).

***Variables collected on diseased animals for the first time*:** Date, cause (eg. respiratory complex, diarrhea, pain, claudication, etc.), place of treatment (hospital or pen), weight (kg), and rectal temperature (C).

***Variables collected on diseased animals for the second time*:** Date of treatment (if performed), cause, place of treatment (hospital or pen), weight (kg), and rectal temperature (^{0}C).

***Variables collected on diseased animals for the third time*:** Date of treatment (if performed), cause, place of treatment (hospital or pen), weight (kg), and rectal temperature (^{0}C).

Data Analysis

Based on the records of the period under study, tables were drawn using Microsoft Excel. Also, the values for several variables were calculated using descriptive statistics (mean ± standard deviation). Some relevant variables were:

***Feedlot characteristics*:** total inventory, replacements entries per month.

***BRDC characteristics*:** Time between arrival and first treatment (days), total and average number of cases per month, total and average number of BRDC cases per month, total and average number of BRDC cases per season, total and average number of BRDC cases by provenance, total and average number of BRDC cases per weight category, total and percentage of deaths by BRDC during the study period, total of animals receiving a second treatment for BRDC, time between arrival and second treatment (days), time between first and second treatment for BRDC (days), total cases in third treatment for BRDC, BRDC morbidity related to total inventory and to incoming animals (%), treatment effectiveness (%), and lethality (%).

Results and Discussion

Inventory analysis of the feedlot Dos Matas

In the study period the pens received a total of 260,211 animals, with a monthly average inventory of 20,016 ± 607.24. The total number incoming steers was 67,467 steers, averaging 5,190 ± 1251.96 per month. The total inventory increased progressively due to a market opportunity, thus the enterprise increased its capability to receive and raise animals (Table 1).

Analysis of animals affected by BRDC at first treatment

Throughout the study period, the number of animals treated in pen was lower than those treated in hospital. Only those who had difficulty in moving or with a serious illness were treated in corral. There were 12,783 cases of bovine respiratory disease (18.9% of all animals that entered the feedlot). BRDC cases accounted for between 84.5 and 99.9% of all identified cases of disease (95.18 ± 5.10% per month), which is higher than the figures reported by Edwards (1996), who mentions that 65 to 80 % of disease occurs in the first 45 days and 67 to 82% of the total mortality due to respiratory disease (in average, so BRDC was responsible for 75% of cases of disease). In this study, most cases detected in the first weeks after arrival corresponded to BRDC, but also other less frequent problems were diagnosed, such as claudication, balanoposthitis, diarrhea, and even a case of vesicular stomatitis, a disease rarely observed in this feedlot. Such case was recorded on March 2010. Edwards (1996) analyzed the records of feedlots, of the total reported, respiratory diseases were predominant (67 and 82%), followed by digestive disorders (3-7%), and various other disorders (14-28%) such as prolapse, urinary stones and injuries. Moreover, in a study done on 51 feedlot operations in western France, monitoring the incidence of clinical respiratory disease in 698 beef cattle kept in 68 pens and the exposure to respiratory pathogens after arrival, the risk of respiratory disease incidence was 18.5 % during the first six weeks. Cases occurred in 37 of the 68 pens and 30.9 percent of the animals were affected. The risk of respiratory disease incidence was lower in pens in which the animals had been vaccinated against *M. haemolytica* (Assié et al., 2009).

Body temperature in animals affected by clinical BRDC ranged between 38.8 and 40.8 ^{0}C and 39.23 ± 0.67 ^{0}C in average. The average weight at the first treatment was 335.71 ± 9.78 kg, but the difference between the weights on arrival and at the first treatment averaged 15 kg less.

This is consistent with several reports indicating that BRDC affected animals usually exhibit lower weight gain compared to the healthy ones (Morck et al. 1993; Gardner et al., 1999; Snowder et al., 2006). Sick animals usually decrease their nutrient intake (Galyean et al., 1999) and water (Buhman et al., 2000). In a study done in Canada over a period of 220 days, a group of steers affected by BRDC and receiving an antimicrobial treatment lost an average of 13.2 kg per animal, compared with another group of animal that was not affected by the disease (Bateman et al., 1990).

Table 1: Inventory of the Dos Matas feedlot in Veracruz, Mexico during the period from October 2009 to October 2010

	Total inventory, No.	Monthly incoming, No.	BRDC Cases, No.	Overall Morbidity rate, %	Morbidity rate in incoming steers, %	Total deaths, No.	BRDC deaths, No.	BRDC mortality rate, %	BRDC lethality rate, %	BRDC relapsing cases, No.	First treatment success rate%
2009											
October	19 345	5 113	843	4.36	16.49	45	6	13.33	0.71	65	92.3
November	19 384	4 734	1000	5.16	21.12	17	6	35.29	0.60	97	90.3
December	19 660	5 978	1007	5.05	16.84	27	7	25.92	0.69	50	95
2010											
January	19 789	5 335	1218	6.15	22.83	33	6	18.18	0.49	122	90
February	19 582	4 448	1461	7.46	32.85	32	3	9.37	0.20	172	88.2
March	19 582	5 559	1062	5.42	19.10	17	3	17.64	0.28	94	91.1
April	19 983	4 782	574	2.87	12.00	22	1	0.22	0.17	31	94.6
May	19 356	6 159	744	3.84	12.08	32	5	15.62	0.67	40	94.6
June	20 346	6 156	946	4.69	15.37	25	8	32	0.84	49	94.8
July	20 952	6 271	1051	5.02	16.76	27	13	48.14	1.24	30	97.1
August	20 820	5 850	860	4.13	14.70	42	19	45.23	2.21	42	95.1
September	20 706	5 564	1353	6.53	24.32	58	22	37.93	1.63	113	91.6
October	20 706	1 518	664	3.21	43.74	23	6	26.08	0.90	70	89.5
TOTAL	260 211	67 467	12 783	4.91	18.95	400	105	26.5	0.82	975	92.4

Table 2: Total steers and BRDC cases occurring in the Dos Matas feedlot in Veractuz, Mexico during the period October 2009 to October 2010 according to provenance, season, and weight category

	Steers, No.	BRDC Cases, No (%)	BRDC Relapsed, No. Cases (%)
Provenance			
South Veracruz state	35190	6950 (19.74)	518 (7.45
Chiapas state	10906	2397 (21.97)	188 (7.84)
Northern Chiapas and Tabasco state	10447	1647 (15.76)	128 (7.77
Tabasco state	9757	1702 (17.44)	135 (7.93
Tuxtepec, Oaxaca	1167	87 (7.45)	6 (6.89)
Season			
Fall	17343	2374 (13.69)	242 (24.82)
Winter	15342	4272 (27.85)	354 (36.3)
Spring	17097	2880 16.85)	180 (18.469
Summer	17685	3257 (18.42)	199 (20.41)
Weight Category			
Minimum (less than 300 kg),	20396	4188 (20.53)	367 (8.76)
Small (301 - 330 kg)	12573	2087 (16.59)	131 (6.27)
Medium (331-360 kg)	18278	3265 (17.86)	224 (6.86)
Large (361-390 kg)	11987	1800 (15.02)	123 (6.83)
Extra (over 391 kg)	4233	1443 (34.09)	130 (9.09)
TOTAL / PERCENTAGE	67467	12783 (18.95)	975 (7.63)

Analysis of BRDC affected steers by provenance

During the study period the feedlot had only five suppliers. Each supplier collects cattle in different regions of southern Mexico, gathering animals and periodically sending them to the feedlot. Most steers coming into the feedlot came from southern Veracruz. However, the percentage of sick animals by region of origin ranged from 3.68% (Tuxtepec, Oaxaca) to 19.15%. (Chiapas), suggesting that most remote regions requiring more hours for cattle transportation are a major predisposing factor for the animals to develop the disease, circumstance that has been reported in the literature (Fike and Spire, 2006; Bernardini et al., 2012). According to Tarrant and Grandin (2000), BRDC is the most important health problem associated with cattle transportation. Irwin et al. (1979) estimated that 1% of cattle die due to stress during transport or in the immediate period after it. Hutcheson and Cole (1986) suggested that to reduce the losses of livestock being transported to long distances, a diet containing 50% concentrate before shipping must be provided.

Analysis of BRDC affected steers by season

The months of arrival to the feedlot animals were categorized according to the conventional four season's classification. Most cases were observed in winter (34%), almost doubling fall where the lowest proportion of cases were observed (18.1%) (Table 2). In

spring and summer, the figures were intermediate (22.4 and 25.5%, respectively). This signals weather as a factor in the occurrence of this disease, which has already been mentioned by Vogel and Parrot (1994).

Analysis of BRDC affected steers by body weight

After arrival to pens, steers are separated into batches according to their weight, in order to facilitate handling and to reduce later carcass variability. Heavier animals, the less numerous group, were more susceptible to BRDC (34% of all cases). This group of animals, even though they have a higher body weight, usually arrives at the feedlot with a low body condition and nutritional problems. Lower body weight group, the most numerous, has also more chances to get sick than average weight animals (20.5% of all cases).

BRDC Morbidity, Mortality, and Lethality

Among the optimum parameters that the feedlot "Dos Matas" had set, morbidity is not exceeding 5% over total inventory, or 16% over new incoming animals. In this study, morbidity over total inventory was above the optimum value in eight months, and morbidity over new incoming animals exceeded the optimum value in nine months.

In the particular case of September and October 2010, the high frequency observed in both indicators could be related to the presence of Hurricane Karl (Cruz, 2011), a severe weather event that affected the region in mid-September 2010, and what probably was an extremely stressful factor for a high proportion of animals, particularly to those recently arrived. It is well established that stressors reduce productivity and increase morbidity and mortality (Loerch and Fluharty, 1999).

The total number of dead animals in the study period was 405 (0.0155% of all animal inventory from October 2009 to October 2010). BRDC average mortality was 25.9%, but the proportion of animals killed by BRDC in relation to the total number of deaths varied between 0.22% and 48.1%, with the highest values occurring between July and September 2010. This figure may seem high, but according to Edwards (1996) BRDC can be responsible for 50% of deaths suffered by animals in feedlots. The mortality attributed to BRDC in newly weaned calves, as those used in feedlots, ranged from 0.9 to 1.1% in Ontario (Martin, 1983), 1.18% in Alberta, from 2.5 to 3.0% in southeastern California, 1.4% in northeastern California, and 1% in Colorado 1.0% (Church, 1983). Vogel and Parrot (1994) reported that average monthly mortality due to BRDC in feedlots in California, Colorado, Iowa, Idaho, Kansas, Nebraska, Oklahoma, and Texas, averaged 0.326% and ranged from 0.176 to 0.472.

Regarding BRDC lethality, this had an average of 0.76% over the study period, ranging from 0.17 to 2.21% per month. In 156 feedlots in central France, herd incidence of respiratory disease had an average of 2.52 treatments for 1000 animals/days at risk and a fatality case rate of 6.0% in treated animals (Assié et al., 2001). Edwards (1996) estimated the time when steers got sick and approximately 65-80% of the total morbidity occurred during the first 45 days in the feedlot; after 45 days in the feedlot morbidity reduced to a third of that previous rate.

Analysis of BRCD relapsing steers requiring a second treatment

The average success of the first treatment against BRDC was 92.38%, so only 7.62% animals (975/12783) required a second treatment. Holland et al. (2010) argued that segregation of BRDC animals with CRB, the application of several treatments and proper feeding for recovery can be a viable strategy for increasing animal value. Over twice the number of animals medicated in the pens was treated at the hospital. Average rectal temperature in affected animals was 39.34 ± 0.94 ^{0}C, which does not differed much from the average temperature of animals receiving only one treatment. In this feedlot, second and third treatments against BRDC usually consisted of enrofloxacin or ciprofloxacin in combination with a nonsteroidal anti-inflammatory drug such as megluxin meglumine. Other health conditions requiring medication were cases of lameness, and to a lesser extent, diarrhea, balanoposthitis and one case of vesicular stomatitis.

Analysis of BRCD relapsing steers by month

The goal parameter set in the feedlot Dos Matas for success of the first treatment against BRDC is not less than 85%. Thus, all the months included in the study period exceeded the goal, except for the borderline value of October 2010. The average monthly relapsed animals were 67 ± 41.3, ranging from 31 to 172 cases in April and February, respectively. In addition, from January to March and in September to October, a number of cases above the average were observed. The monthly increase from January to March could result from exposure to a colder weather, with frequent presence of strong winds coming from the north, which represented a severe stress for the animals.

The increased frequency in September could also be associated with the consequential effects of Hurricane Karl (Cruz, 2011), which severely impacted the area in mid-September 2010, by exerting strong winds, abundant rainfall, and mud that contaminated water supply sources, resulting in a negative impact on overall feed conversion, and even interference with mechanical feeding operations.

Analysis of BRDC relapsing steers by season

The largest proportion of BRDC relapsed cases occurred in winter (36.3%), as in those who had the disease for the first time. However, the lowest number of cases took place in spring, while in those sick for the first time this happened in fall. However, the average proportion of cases by season was very similar (about 25%), both in BRDC relapsed cases as in those sick for the first time.

Analysis of BRDC relapsing steers by provenance

According to steers provenance, BRDC relapsed cases had a very wide variation between six (Tuxtepec, Oaxaca) and 518 (south of Veracruz), but animals from the most remote places (Tabasco and Chiapas), as those who became ill for the first time by BRDC, exhibited the highest frequency. It seems that, despite the treatment received, steers that are transported over long distances suffer a stress so strong that they cannot recover properly. One suggestion to avoid problems with animals moved from remote locations is to provide some rest in one or more intermediate points in order to reduce the negative effects of transport.

Analysis of BRDC relapsing steers according to weight

Steers listed under the lightest weight category showed the highest number of BRDC relapsing cases (38%, 362/950), although in percentage terms the proportion (8.64%) was comparable to that of animals in the highest weight category (8.66 %). Morck et al. (1993) estimated that a single episode of BRDC is associated with 0.18 kg less in average daily weight gain, compared to animals that remained healthy, and those who were treated two or more times had 0.33 kg less ADG in the first 90 days of confinement.

Analysis of BRDC relapsing steers requiring a third treatment

Only 11 animals required a third treatment, five of which were medicated in February. The third treatment was applied at an average of 10 days after the second treatment. All cases, except two, were treated in the hospital. Other cases in addition to BRDC requiring a third treatment were of lameness and diarrhea. Due to the small number of cases, a more detailed analysis was not attempted.

Conclusion

This is the first epidemiological study on clinical BRDC the authors are aware of. BRDC morbidity was high (19%), but mortality (0.15%) and lethality (0.76%) were low. Sick animals lost 15 kg. in average between the weight on arrival and the weight at first treatment. The average success of a first treatment against BRDC was 92.4%. Most susceptible steers to BRDC illness were those transported over larger distances, those which arrived in winter, as well as the heaviest and the lightest. Findings of this study suggest that the use of metaphylaxis does not suffice to decrease BRDC cases and to diminish the negative impact. Thus, other strategies, such as preconditioning programs and measures to overcome the identified risk factors must be considered.

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