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Clinical and metabolic indicators associated with early mortality at a milk-fed veal facility: A prospective case-control study

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ABSTRACT

Antimicrobial use and resistance, in combination with high levels of mortality, are important challenges facing the veal industry. To improve both the economic sustainability of the industry and animal welfare, measures need to be taken to explore and address reasons for these challenges. Health status at arrival may be an important predictor of calf mortality because substantial mortality occurs early in the growing period on veal operations. The objective of this observational case-control study was to identify clinically measurable variables and metabolic indicators associated with mortality in the first 21 d following arrival at a veal facility. Calves were evaluated using a standardized health scoring system, blood was collected, calves were weighed, and the supplier of the calf was recorded at arrival. The calves were followed until death or 21 d after arrival. Cases were defined as calves that died ≤21 d following arrival. Two controls for every case were randomly selected from calves that survived >21 d, arrived on the same day, and were housed in the same barn as cases. Stored serum harvested at arrival from cases and controls was submitted for measurement of concentrations of nonesterified fatty acids, β-hydroxybutyrate, glucose, cholesterol, urea, haptoglobin, and immunoglobulin G. A conditional logistic regression model was built to evaluate factors associated with mortality ≤21 d following arrival. A total of 4,825 calves were evaluated from November 2015 to September 2016. The mortality risk in the first 21 d was 2.8%, giving 135 cases, which were compared with 270 controls. Six variables were significant in the final multivariable model. Calves with a slightly enlarged navel with slight pain or moisture, and those with severe dehydration had increased odds of mortality ≤21 d following arrival. Drover-derived calves, calves that weighed more, and calves that had higher concentration of immunoglobulin G or cholesterol at arrival were less likely to die. The results demonstrate that calves at elevated risk for early mortality can be identified at arrival using both health and hematological factors. Early recognition of high-risk calves may allow for an intervention that could result in improvement in survival rates; however, prevention of these abnormalities before arrival at veal facilities needs to be further explored.

Key words: antimicrobial use, veal industry, calf health status, case-control study

INTRODUCTION

Calf morbidity and mortality represent a significant cost to calf-rearing industries (Mohd Nor et al., 2012) and an important concern for animal welfare (Ortiz-Pelaez et al., 2008). With mortality ranging from 5 to 8% in conventional veal housing (Pardon et al., 2012a; Winder et al., 2016) and 4% in animal welfare–specific housing (Bähler et al., 2012; Lava et al., 2016), there is a clear need to address its occurrence. The intensive use of antimicrobials is another important challenge faced by the veal industry (Pardon et al., 2014). In Europe, the veal calf sector uses high levels of antimicrobials (Pardon et al., 2012b; Bos et al., 2013; Lava et al., 2016); however, in Canada and the United States, the amounts used are unknown. The level of antibiotic use in the veal industry has been associated with the emergence of antimicrobial resistance in commensal, pathogenic, and zoonotic bacteria (Catry et al., 2007, 2016; Cook et al., 2011). This highlights the urgent need for change in the veal industry (CVMP-BIOHAZ, 2017), but for the industry to remain viable, controllable risk factors need to be identified and modified to decrease morbidity and mortality.

Because most mortality occurs during the early portion of the growing period, this may provide an initial area of focus (Pardon et al., 2012a; Winder et al., 2016). Health status and weight upon arrival at a veal facility can aid in the prediction of mortality early in the growing period (Bähler et al., 2012; Winder et al., 2016; Renaud et al., 2018). However, metabolic indicators may also play a role in identification of calves that are at increased risk of morbidity or mortality.

Colostrum management could be a key factor contributing to calf losses in male calf rearing (Godden,

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2008). Immunoglobulin G and total protein can both be used as markers for colostrum intake, with IgG being more specific in identifying failure of passive transfer (Weaver et al., 2000). Currently, the only tests that directly measure serum IgG are ELISA and radial immunodiffusion (Weaver et al., 2000). However, given the semiquantitative nature of the ELISA, radial immunodiffusion is the gold standard test (Fecteau et al., 2013). Failure of passive transfer is a common problem in male calves (Trotz-Williams et al., 2008; Pardon et al., 2015), and a strong association between serum IgG concentration and morbidity in male calves has been found (Pardon et al., 2015). However, a clear link between IgG status and mortality has not yet been established in the veal industry.

The acute phase response is a nonspecific reaction that occurs in response to tissue injury and leads to the production of acute phase proteins. Haptoglobin is an acute phase protein that increases in serum during bacterial and viral disease (Gånheim et al., 2007). It has been used to identify calves with pneumonia (Angen et al., 2009) and as a prognostic tool for calves with diarrhea (Hajimohammadi et al., 2011). Upon arrival of calves at a veal facility, the level of alpha-2 globulins—of which haptoglobin is a fraction—has been shown to affect neonatal calf diarrhea and average daily gain (Pardon et al., 2015). As the concentration of haptoglobin is low in healthy calves (Gånheim et al., 2003), it could be used as a screening tool to identify diseased calves soon after arrival at a veal facility.

Improved energy status protects against disease and supports immune function (Todd et al., 2017). It has been reported that 17% of surveyed Canadian dairy source farms providing inferior nutrition to male calves compared with female calves (Renaud et al., 2017), and this, combined with the energy expenditure and mobilization occurring during calf transport (Knowles et al., 1999), means that many male calves enter the veal industry with suboptimal energy status and low body fat cover (Wilson et al., 2000). Serum concentrations of BHB, nonesterified fatty acids (**NEFA**), cholesterol, glucose, and urea could all serve as markers of energy status in calves.

The objective of this study was to identify clinically measurable health and metabolic indicators associated with mortality occurring in the first 21 d following arrival at a veal facility.

MATERIALS AND METHODS

This observational case-control study was conducted in cooperation with a single milk-fed veal calf producer and in accordance with the University of Guelph Animal Care Committee (Animal Use Protocol: #3453). The producer had 5 barns in different geographical locations in southwestern Ontario, Canada. The diet provided to the calves did not differ by barn but there were several management differences. Barns 1, 2, and 4 fed calves manually, whereas barns 3 and 5 used automated calf feeders. Calves were housed individually in barns 1 and 4 and in groups of 60 calves in barns 3 and 5. Barn 2 housed calves in individual pens in early life, transitioning to groups of 8 calves at 5 to 6 wk following arrival.

Data Collection

When calves arrived at the receiving facility, they were immediately evaluated using a standardized health scoring system and weighed with a digital weighing scale (Cardinal Scale Manufacturing Co., Webb City, MO). The supplier of the calf and arrival date were also recorded. The suppliers were placed into 3 categories: local, drover, and auction. "Local" refers to dairy farmers who delivered calves directly to the veal facility. "Drover" refers to calves transported from multiple dairy farms to the veal facility and "auction" were calves derived from auction facilities. Calves were identified on arrival based on their Canadian Cattle Identification Agency ear tag using a handheld radiofrequency ID (RFID) reader. Mortalities occurring during the growing period were recorded using an electronic recording database (Trax-IT; Merit-Trax Technologies, Mount Royal, Quebec, Canada).

Standard Health Scoring System

An iPad (Apple Inc., Cupertino, CA) with the Calf Health Scorer app (University of Wisconsin-Madison, Madison, WI) and Qualtrics software (http://www.qualtrics.com/) was used to facilitate the health scoring. The Calf Health Scorer app provided images and descriptions to evaluate the respiratory system (nose, eye, ear, cough; McGuirk and Peek, 2014), fecal consistency (McGuirk, 2008), navel inflammation (adapted from Fecteau et al., 1997), joint swelling, and rectal temperature. A Qualtrics form was used to collect data on the evaluation of dehydration (Wilson et al., 2000), BCS (Wilson et al., 2000), and sunken flank (Bähler et al., 2012; Table 1). All calves were examined by 1 of 3 observers; however, all case and control triads were evaluated by the same observer.

Blood Collection and Processing

Following the health examination, approximately 10 mL of whole blood was collected from the jugular vein into a sterile blood collection tube without an antico-