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ESTIMATION OF OUTCOME OF UMBILICAL DISEASES BASED ON CLINICAL EXAMINATION: A RETROSPECTIVE STUDY INVOLVING 322 CALVES

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Abstract

Ultrasonography is the most reliable examination in the diagnosis of umbilical diseases in calves. However, a large number of veterinarians are not capable of performing ultrasonographic examination. Therefore, the aim of this study was to assist practitioner in consideration of easily obtained clinical findings and possible outcome of the umbilical diseases according to clinical score. Medical records of owned 322 calves with different umbilical diseases (Omphalitis, umbilical abscess, urachal infection, umbilical hernia, omphalophlebitis, umbilical abscess+umbilical hernia, omphalitis+umbilical hernia) were reviewed. Clinical findings of each calf were pointed according to clinical scoring system. Surgery was performed in all types of umbilical diseases except for calves in group of omphalitis (medical treatment). The clinical score of animals was significantly changed according to umbilical disease. The highest clinical score was obtained in calves group of umbilical abscess+umbilical hernia (16.21±0.35). However, the calves in group of umbilical hernia (2.29±0.38) had the lowest clinical score. The clinical score with the highest specificity and sensitivity was >15 (sensitivity = 100 %, specificity = 91.5 %). A clinical score > 15 was associated with mortality rate of 98 % (95 % CI = 96-100). Mortality rates of omphalophlebitis, umbilical abscess+umbilical hernia and umbilical abscess were 16.7% (4/24), 15.2% (5/33) and 9.6% (7/73), respectively. Overall, 95% (306/322) of our calves were survived one-month following surgery. In conclusion, the clinical score has an important role for outcome of the umbilical disease in calves.

Key words*: calves, clinical score, omphalitis, ultrasonography, umbilical disease.*

INTRODUCTION

Early postnatal period is one of the most challenging factors in calf health accompanied by the umbilical diseases (UDs) (Brenner and Ungar-Waron, 1996; Desrochers and Francoz, 2014). Insufficient hygiene and poor maintenance of umbilical cord immediately after birth are the most important predisposing factors (Rademacher, 2006; Steiner, 2006). The UDs have been classified as infectious (omphalitis, omphalophlebitis, omphalo-arteritis, urachal infection, and umbilical abscess) and noninfectious (umbilical hernia) diseases. The umbilical region becomes painful in palpation, and abscess formation may occur (Kilic et al., 2015). Occasionally, concurrent infection of umbilical hernia may occur (Trent and Smith, 1984; Steiner, 2006; Sutradhar et al., 2009). In addition to clinical examination, ultrasonography helps determine the inflamed structures, extension of the disease, treatment strategy, and prognosis in UDs (Watson et al., 1994; Staller et al., 1995; O'Brien and Forrest 1996; Steiner and Lejeune, 2009; Braun and Kruger, 2013; Kurt and Cihan, 2013). At the time of clinical examination, the practitioner may wish to estimate clinical outcome based on the symptoms and findings, especially in case of unavailability of ultrasonography. The objective of this retrospective study was to highlight the clinical finding and prevalence of UDs in calves, and to determine the relationship between outcome of the disease and clinical score at clinical examination.

MATERIALS AND METHODS

Animal: Medical records of 322 (196 males, 60.9% and 126 females, 39.1%) calves presented during between April-2005 and November-2015 were retrieved retrospectively. The breed distribution was Brown Swiss (143; 44.4%), Holstein (112; 34.8%), Simmental (50; 15.5%), and East Anatolian Red (17; 5.3%). The median age of calves was 10.98 days (3-35) with the median weight of 50 kg (30-80).

A thorough history was obtained for each calf focusing on other systemic problems. Povidone-iodine had used to clean umbilical cord in 14 newborn calves (4.34%) by owners. Sixty-eight calves (21.11%) had received medical different antibiotics at different dosage and days before referred to our clinic. Two-hundred-ninety-three of 322 cases (91%) presented with a history of umbilical swelling, while 29 calves (9%) had presented with other problems such as diarrhea and coughing.

Clinical diagnosis and treatment: Clinical diagnosis of the cases was determined by physical and ultrasonographic examinations. Deep palpation of the abdomen was done to identify the involvement of intraabdominal umbilical structures such as umbilical vein, urachus, and umbilical artery. For ultrasonographic (Esaote Falco 100, PIE Medical, Maastrich, Netherlands) examination, areas cranial to the xiphoid and caudal to the scrotum/teats were clipped, and contact gel was applied at the cranial and caudal areas to the umbilicus and center of the umbilicus. A 7.5-MHz sector transducer (Radius 17, PIE Medical, Maastrich, Netherlands) was used to evaluate the umbilical structures when the animal was on standing position.

Omphalitis was diagnosed when there was a painful hard tissue swelling and an increased diameter of extra-abdominal structures as well as presence of homogenous hypoechoic content in sonography. Umbilical abscess was considered when there was a non-reducible umbilical mass and soft tissue swelling, and sonographic evidence of increased diameter of extra-abdominal structures, homogenous hypoechoic content, and anechoic areas. Urachal infection was suspected based on swelling in intra-abdominal structures, sonographic evidence of increased diameter of urachus, and anechoic content in urachus lumen. Umbilical hernia was defined as reducible mass and breaking in the body wall in ultrasound. Omphalophlebitis was defined as swelling in intra-abdominal structures and sonographic evidence of cranial thickening of the umbilical cord. Umbilical hernia with umbilical abscess was defined as reducible umbilical mass and sonographic evidence of homogenous hypoechoic content with anechoic areas, and breaking in the boy wall. Umbilical hernia with omphalitis was diagnosed when there was a painful hard tissue swelling, and sonographic evidence of breaking in the body wall and homogenous hypoechoic content (Edwards, 1992; Steiner and Lejeune, 2009). Each animal during the examination was subjected to the modified clinical scoring system (Table 1) (Fecteau et al., 1997).

Table 1. Clinical scoring system (0-20 points)*

Criterion	Point
1. Rectal temperature (°C)	
< 39.5	0
≥ 39.5	2
2. Heart rate (beat per minute)	
70-140	0
> 140 or < 70	2
3. Respiratory rate (count per minute)	
< 35	0
≥ 35	2
4. Coughing	
Absent	0
Present	2
5. Diarrhea	
Absent	0
Present	2
6. Appetite	
Normal	0
Sluggish	2
Absent	4
7. Joint swelling	
Absent	0
1 joint affected	2
> 1 joint affected	4
8. Day to occurrence of disease	
1-4	0
5-9	1
> 9	2

*Adapted from Fecteau et al. (1997).

Amoxicillin clavulanic acid (Synulox, Pfizer, Istanbul, Turkey) 7 mg/kg im for 7

days and meloxicam (Bavet Meloxicam, Bavet, Istanbul, Turkey) 0.5 mg/kg for 5 days were used in cases of omphalitis (n=86; 26.70%). The calves (n=236, 73.30%) with umbilical hernias, umbilical abscess, urachal infections, omphalophlebitis, and umbilical hernia with omphalitis and umbilical abscess were operated using the standard procedures (Trent and Smith, 1984; Baird 2008; Williams et al., 2014; Marchionatti et al., 2016). The combination of 10.000 IU/kg benzyl penicillin procain and 10 mg/kg dihydrostreptomycin (Reptopen-S, Ceva-Dif, Istanbul, Turkey) was administered im for postoperative 7 days. To prevent occurrence or recurrence of umbilical hernia, belly bandage was performed. Calves were discharged 6-8 hours postoperatively. During this period, 0.9% NaCI and 5% glucose solution (5 mL/kg) were administered intravenously. Food was withheld for 18 hour postoperatively. Belly bandage and skin sutures were removed on the 10^{th} post-operative day. In all cases, owners were contacted by phone during the postoperative or posttreatment one month and calf health was reported.

Statistical Analysis: Cross-tables were established using the Chi-square test to evaluate if there was association of breed and gender with the UDs. One-way ANOVA was performed to attain differences in clinical score by the diseases, employing the Duncan's Multiple Range Test option (SPSS, version 19.0, SPSS Inc, Chicago, IL). Furthermore, a receiver operating characteristic (ROC) curve was generated to determine sensitivity and specificity of the clinical score at the highest Youden Index in determination of the outcome of UDs (MedCalc, version 16.1, MedCalc Software bvba, Ostend, Belgium). Statistical significance was considered at P value less than 0.05. The results are presented as means±standard error.

RESULTS

Omphalitis (n = 86, 26.70%) was the most common umbilical disease, followed by umbilical abscess (n = 73, 22.67%), urachal infection (n=52, 16.14%), umbilical hernia (n=28, 8.69%), omphalophlebitis (n=24, 7.45%), umbilical hernia with umbilical abscess (n=33, 10.24%), umbilical hernia with omphalitis (n=26, 8. 07%) (Table 2). There was no significant breed (X^2=9.45 P=0.95) and gender (X^2=2.08, P=0.91) association with the UDs.

The clinical score varied by the UDs. The highest clinical score was obtained in calves with umbilical hernia plus umbilical abscess (16.21±0.35), whereas the lowest score was obtained in calves with umbilical hernia (2.29±0.38) (Table 2).

At the cut-off value of the clinical score > 15 for the clinical outcome (dead, n=16, 5% *vs*. recovered, n=306, 95%), sensitivity was 100% (79.4-100, 95% CI) and specificity was 91.5 (87.8-94.4, 95% CI) with positive likelihood ratio of 11.8 and negative likelihood ratio of 0 (Fig 1).

Overall mortality rate was 5% in calves with various UDs. The clinical outcome was related to neither breed (X^2=2.39, P=0.49) nor gender (X^2=0.15, P<0.70). However, there was a significant umbilical disease and outcome association (X^2=27.54, P=0.0001). The highest mortality occurred in calves with omphalophlebitis (4/24, 16.67%), followed by ones with umbilical hernia with umbilical abscess (5/33, 15.15%) and umbilical abscess (7/73, 9.59%). There was no mortality in calves with other UDs. Among the calves undergone surgical treatment, mortality rate was insignifant (X^2=0.58, P=0.27).

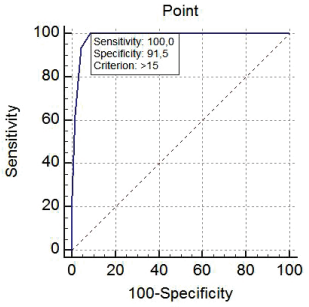

Fig. 1. Sensitivity and specificity of the clinical score in determination of the outcome [dead, 16 (4.97%) *vs.* survived 306 (95.03%)] of the umbilical diseases. Area under curve was 0.98±0.01 (0.96-1.00 at 95% CI, Z=77.11, P<0.0001).

Table 2. Prevalence and clinical score of the umbilical diseases (n=322)

Disease	Prevalence (n, %)	Clinical Point		Mortality (n)
		Mean±SE	95% CI	
Omphalitis	86 (26.70)	4.15±0.22[e]	3.73-4.57	0
Umbilical abscess	73 (22.67)	14.01±0.23[b]	13.55-14.47	7
Urachal infection	52 (16.14)	5.65±0.28[d]	5.11-6.20	0
Umbilical hernia	28 (8.69)	2.29±0.38[f]	1.54-3.03	0
Omphalophlebitis	24 (7.45)	14.33±0.41[b]	13.53-15.13	4
Umbilical hernia with umbilical abscess	33 (10.24)	16.21±0.35[a]	15.53-16.90	5
Umbilical hernia with omphalitis	26 (8. 07)	10.27±0.39[c]	9.50-11.04	0

Means with different superscripts[a-f] within the same column are statistically different (P<0.05)

The outcome was related to treatment approach (X^2=6.14, P=0.008). Calves with the UDs subjected to medical treatment recovered, whereas 16 of those subjected to surgical intervention died on the 2-5th day postoperation. 220 calves with the UDs subjected to surgical intervention were reported to survive one-month following surgery.

DISCUSSIONS

Whenever ultrasonography is unavailable, estimation of the outcome of the UDs based on the clinical score given during clinical examination can be valuable. Clinical score is comprised of routine physical findings such as rectal temperature, appetite, presence of coughing and diarrhea, heart and respiratory rates, which are the main responses to diseases (Smith, 2005). Arthritis is the frustrating complication of UDs, and commonly observed when the umbilical infection spreads the joints via the hematogenic route (Constable, 2007;

Marchionatti et al., 2016). Furthermore, time to occurrence of umbilical disease is important to decide whether the disease is in acute or chronic stage, which can also affects the prognosis of the disease (Cihan et al., 2006).

There were no associations of breed and gender with the prevalence of umbilical disease.

Despite lacking gender predisposition (Herrmann et al., 2001), Holsteins were more susceptible to umbilical hernia (Steenholdt and Hernandez, 2004). The UDs may exist with complications. In agreement with the literature (Baxter, 1989), prevalence of umbilical hernia was 8.69%. In the present study, concurrent infection of umbilical structures with umbilical hernia was encountered in 59 calves (18.32%) (33 with umbilical abscess and 26 with omphalitis) which was lower than a previous report 25% (Steiner, 2006). Previous studies have reported that urachal infection is the most common disease of umbilical cord remnants (Staller et al., 1995; Baird, 2008; Rodrigues et al., 2010). In this study, the most common umbilical disease was omphalitis, followed by umbilical abscess and urachal infection. There was no calf with omphaloarteritis, which is rarely encountered umbilical disease (Kilic et al., 2005; Hopker, 2014).

Diagnosing the type of umbilical disease is important in deciding which treatment (medical or surgery) is appropriate (Trent and Smith, 1984; Rademacher, 2006; Baird, 2008). Antibiotics should be the first option for the treatment of omphalitis (Steiner et al., 1993; Rings, 1995). However, surgical intervention is necessary for other umbilical infections that can extend to other organs and are accompanied by systemic problems such as pneumonia, arthritis, cystitis, peritonitis, hepatitis, and liver abscess (Selig et al., 2015). Previous studies have stated that uncomplicated umbilical hernias are mainly

closed spontaneously when the defect is smaller than one finger [Edwards, 1992, Hopker, 2014). However, umbilical hernias tend to enlarge with age, resulting in strangulation (Virtala et al., 1996).

The outcome of umbilical disease is strongly correlated with the type of umbilical disease (Baxter, 1989). The omphalophlebitis with septic arthritis or liver abscess has a worse prognosis (Desrochers and Francoz, 2014). A previous study reported mortality rate of omphalophlebitis as 15% (Marchionatti et al., 2016). The highest mortality rate (16.67%) was noted in calves with omphalophlebitis in this study. The mortality rate for umbilical hernia complicated with umbilical abscess was reported to be 29% (Geishauser and Grunder, 1992), which was much higher than prevalence in the present study (15.15%). In agreement with the literature (Williams et al., 2014), overall mortality rate resulting from the umbilical diseases was about 5%.

In the present study, calves with omphalophlebitis, umbilical abscess, and umbilical hernia with umbilical abscess had high clinical score. Some of these animals with high clinical score did not respond to treatment and died. Omphalitis, urachal infection, umbilical hernia with omphalitis and uncomplicated umbilical hernia responded to the treatment, which could partially be related to their low clinical score. Based on our clinical score at the cut-off value >15 for outcome of the UDs (sensitivity = 100 %, specificity = 91.5 %), calves were likely to die despite receiving treatment. As the pre-diagnostic status and condition of calves becomes worse, the clinical score is likely to be > 15. For instance, severe inappetance, hyperthermia, having more than 1 joint affected and delayed intervention would contribute to higher clinical score, achieving less satisfactory remission.

In conclusion, a number of factors may affect the clinical outcome of the UDs, which can span from pre-diagnosis stage (physical status, environmental conditions, causative agents, response to intial approaches, etc.) to during and post-treatment care (surgeon skill, owner attitude, housing conditions, continuation of suggested treatment protocol, etc.). This study focused only association of clinical score at time of diagnosis with the clinical outcome. The clinical score was highest for concurrent infection of umbilical hernia and omphalophlebitis. Clinical score at cut-off value >15 had high sensitivity (100%) and specificity (91.5%) for the outcome of the UDs.

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