Estimating the Outcome of Umbilical Diseases Based on Clinical Examination in Calves: 322 Cases

Yanmaz, L. E.,[1]* Dogan, E.,[1] Okumus, Z.,[1] Kaya, M.[2] and Hayirli, A.[3]

[1] Department of Surgery, Faculty of Veterinary Medicine, Atatürk University, Erzurum, Turkey.
[2] Akdeniz University, Health Services Vocational College, Medical Imaging Techniques Program, Antalya, Turkey.
[3] Department of Animal Nutrition and Nutritional Disorders, Faculty of Veterinary Medicine, Atatürk University, Erzurum, Turkey.

* **Corresponding author:** Prof. Latif Emrah Yanmaz, Department of Surgery, Faculty of Veterinary Medicine, Atatürk University, 25240, Erzurum, Turkey. Phone: +90 442 231 71 52, Fax: +90 442 231 72 44. Email: latifemrahyanmaz@gmail.com

ABSTRACT

This study was conducted to determine relationship between clinical score and the outcome of umbilical diseases (UDs). Medical records of 322 calves with various UDs were compiled retrospectively. Each calf was given clinical score based on findings (i.e., rectal temperature, heart and respiration rates, appetite, presence of coughing and diarrhea, joint involvement and day to diagnosis) at clinical examination. Calves with umbilical hernia complicated with umbilical abscess had the highest clinical score (16.21±0.35), whereas calves with umbilical hernia had the lowest clinical score (2.29±0.38). Sensitivity and specificity of the clinical score at the cut-off value >15 for the clinical outcome (dead, n=16, 5% *vs.* recovered, n=306, 95%) were 100% and 91.5%, respectively. In conclusion, the clinical score has a merit for estimating the clinical outcome in cases of UDs. The surgeon skill/experience, factors causing UDs, and postoperative management may also affect the clinical outcome, which were not considered in the present research.

Keywords: Calf; Umbilical Abscess; Umbilical Hernia; Clinical Score.

INTRODUCTION

Early postnatal period is one of the most challenging factors in calf health accompanied by the umbilical diseases (UDs) (1, 2). Insufficient hygiene and poor maintenance of umbilical cord immediately after birth are the most important predisposing factors (3, 4). The UDs have been classified as infectious (omphalitis, omphalophlebitis, omphaloarteritis, urachal infection, and umbilical abscess) and non-infectious (umbilical hernia) diseases. The umbilical region becomes painful on palpation and abscess formation may occur (5). Occasionally, concurrent infection of the umbilical hernia may develop (4, 6, 7).

In addition to clinical examination, ultrasonography may help determine the inflamed structures, extension of the disease, treatment strategy and prognosis in UDs (8-13). At the time of clinical examination, the practitioner may wish to estimate clinical outcome based on the symptoms and findings, especially in case of non-availability of ultrasonography. The objectives of this retrospective study were to highlight the clinical findings and prevalence of UDs in calves, and to determine the relationship between outcome of the UDs and clinical score at clinical examination.

MATERIALS AND METHODS

Animals

Medical records of 322 (196 males, 60.9% and 126 females, 39.1%) calves presented during to the Surgery Clinic of Veterinary Faculty, Ataturk University, Erzurum, 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 days) with the median weight of 50 kg (30-80 kg).

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

Clinical diagnosis and treatment

At the time of referral to our clinics, each calf was physically and clinically examined. Based on the clinical examination, each calf was subjected to a modified comprehensive clinical scoring system (Table 1) as outlined elsewhere (14). Briefly, 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 (15).

Clinical diagnosis of the cases was determined by physical and ultrasonographic examination. Deep palpation of the abdomen was carried out to identify the involvement of intra-abdominal umbilical structures such as the 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 in a standing position.

Omphalitis was diagnosed when there was a painful hard tissue swelling and an increased diameter of extra-abdominal structure as well as the presence of homogenous hypoechoic content on sonography (12). Umbilical abscesses were 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 (13). Urachal infection was suspected based on swelling in intra-abdominal structures, sonographic evidence of increased diameter of ura-

chus, and anechoic content in urachus lumen (16). Umbilical hernia was defined on ultrasound as a reducible mass as a result of a break in the body wall (17). Omphalophlebitis was defined as swelling in intra-abdominal structures and sonographic evidence of cranial thickening of the umbilical cord (18). Umbilical hernia with umbilical abscess was defined as reducible umbilical mass and sonographic evidence of homogenous hypoechoic content with anechoic areas, and a break in the body wall (12). Umbilical hernia with omphalitis was diagnosed when there was a painful hard tissue swelling, and sonographic evidence of a break into the body wall with homogenous hypoechoic content (16).

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

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

Criterion	Point
1. Rectal temperature (℃)	
< 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).

with omphalitis and umbilical abscess were operated using standard procedures (7, 18-20). The combination of 10,000 IU/kg benzyl penicillin procaine and 10 mg/kg dihydro-streptomycin (Reptopen-S, Ceva-Dif, Istanbul, Turkey) was administered intramuscularly (i.m) postoperatively for 7 days. To prevent occurrence or recurrence of umbilical hernia, belly bandages were put in place.

Calves were discharged 6-8 hours postoperatively. During this period, 0.9% NaCl and 5% glucose solution (5 mL/kg) were administered intravenously. Food was withheld for 18 hour postoperatively. Belly bandages and skin sutures were removed on the 10th post-operative day. In all cases, owners were contacted by phone for one month during the post-operative or post-treatment period 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 assess 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 were presented as mean±standard error.

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 differ ($P<0.05$).

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 (Figure 1).

Overall mortality rate was 5% in calves with various UDs. The clinical outcome was related neither to breed (X^2=2.39, P=0.49) nor gender (X^2=0.15, $P<0.70$). However, there was
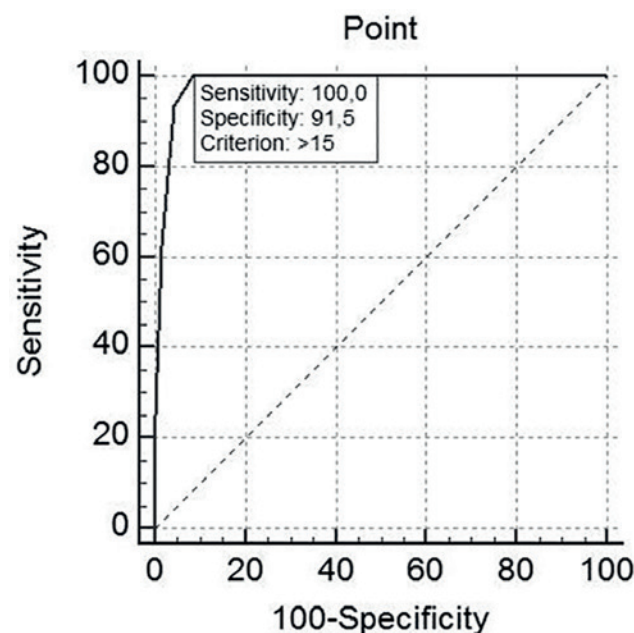
Figure 1: Sensitivity and specificity of the clinical score in determination of the outcome [dead, 16 (4.97%) *vs.* survived 306 (95.03%)] of the umbilical diseases. Area under curve was 0.98±0.01 (0.96-1.00 at 95% CI, Z=77.11, $P<0.0001$). A Youden index of 0.92, sensitivity and specificity were 100 (79.4-100, 95% CI) and 91.50 (87.8-94.4, 95% CI) with a positive likelihood ratio of 11.77 and a negative likelihood ratio of 0.

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 which underwent surgical treatment, mortality rate was insignificant (X^2=0.58, P=0.27).

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 post surgery. 220 calves with the UDs subjected to surgical intervention were reported to survive one-month following surgery.

DISCUSSION

Whenever ultrasonography is unavailable, estimation of the outcome of the UDs based on the clinical score given during clinical examination can be valuable. Time to occurrence of umbilical disease is important to decide whether the disease is in acute or chronic stage, which can also affect the prognosis of the disease (21). Moreover, development of complications could aggravate prognosis and reduce remission in response to treatment. For instance, arthritis is a commonly observed frustrating complication of UDs when the umbilical infection spreads to the joints via the hematogenic route (19, 22).

There was no association of breed and gender with the prevalence of umbilical disease. Despite lacking gender predisposition (17), Holsteins were more susceptible to umbilical hernia (23). The UDs may exist with complications. In agreement with the literature (24), prevalence of umbilical hernia was 8.69%. In the present study, concurrent infection of umbilical structures with umbilical hernia was encountered in 59 of calves (18.32%) (33 with umbilical abscess and 26 with omphalitis) which was lower than a previous report 25% (4). Previous studies have reported that urachal infection is the most common disease of umbilical cord remnants (11, 18, 25). In the present study, the most common umbilical disease was omphalitis, followed by umbilical abscess and urachal infection. There was no calf with omphaloarteritis, which is a rarely encountered umbilical disease (5, 26).

Diagnosing the type of umbilical disease is important in deciding which treatment (medical or surgery) is appropriate (3, 7, 18). Antibiotics should be the first option for the treatment of omphalitis (27, 28). 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 abscesses (29). Previous studies have stated that uncomplicated umbilical hernias are mainly closed spontaneously when the defect is smaller than 2 cm (16, 30). However, umbilical hernias tend to enlarge with age, resulting in strangulation (31).

The outcome of umbilical disease is strongly correlated with the type of umbilical disease (24). The omphalophlebitis with septic arthritis or liver abscess have a poorer prognosis (2). A previous study reported mortality rate of omphalophlebitis as 15% (19). 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% (32), which was much higher than prevalence in the present study (15.15%). In agreement with the literature (20), 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 scores. Some of these animals with high clinical scores 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 was likely to be greater than 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 the pre-diagnostic stage (physical status, environmental conditions, causative agents, response to initial approaches, etc.) to during and post-treatment care (surgeon skill, owner attitude, housing conditions, continuation of suggested treatment protocol, etc.). This study focused only on the association of clinical score at the 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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