

Retrospective Study of Mortality Rates and Prognostic Indicators of Equine Colic in Korea

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(Accepted: January 28, 2015)

Abstract : Equine colic is a major concern in equine industry due to high morbidity and mortality rates. The purpose of this study was to establish mortality rates during medically and surgically treated colic and to identify potential prognostic indicators for mortality of equine colic in Korea. The overall mortality rate was 18/119 (15%). The 93 cases (78%) were treated medically and 26 cases (22%) surgically out of the 119 records reviewed. The mortality rate in small intestinal lesion was 7/9 (78%) and strangulating lesion was 10/11 (91%). The significance between individual factors and prognosis of equine colic was not valid but high frequency rate was found in ≤ 3 years age (59%) and male (50%). In dead group showed higher, rectal temperature and heart rate than those of survived group. The mortality rate was significantly high in the pale mucous membrane color and severe pain and decreased intestinal motility. In laboratory factors, dead group showed lower level of platelet than survived group, and had higher values of RBC, hemoglobin, PCV with significance ($P < 0.05$). Group with increased enzyme activity of CK, LDH, glucose showed poor prognosis.

Key words : Equine colic, morbidity rate, mortality rate, prognostic indicators.

Introduction

Equine colic is a term used to describe horses showing signs of acute abdominal pain. The colic is a major concern in equine industry due to high morbidity and mortality rates (15,17). According to the previous studies based on real population, 28% of all equine fatalities were due to colic (17). Within a year, 3.5 and 10.5 colic cases per 100 horses are expected to have a colic (9,17). Immediate and accurate clinical decision reduces the unnecessary procedures and the consequent economical losses (16). However, it is often difficult to find whether the horse has irreparable injury which cannot be cured by operation or intensive care (17).

Equine colic can be categorized as obstruction, enteritis, strangulation, nonstrangulating infarction, peritonitis, ulceration or ileus by associated lesions (17). In general, a correct diagnosis is necessary to predict a reliable prognosis. However, correct clinical diagnosis of site and type is often difficult in colic cases (1). Nonspecific colic cases without a diagnosis referred as medical, spasmodic, or mild colic (17).

Epidemiological information of prognostic indicators helps us to make a decision regarding the treatment and management of colic cases. Epidemiological studies also provide important information about incidence, mortality and risk factors (18). General studies, which included mortality rates in medical and surgical treated colic cases, have been pub-

lished over 30 years (3) suggesting that recently updated and locally accurate case fatality rate data are useful for clinical decision making (10). Many studies have identified cardiovascular status and pain as associated with colic mortality. Several studies with different results on prognostic factors (5). To evaluate the prognostic indicators in equine colic, preceding studies used many statistical techniques. With the development of statistics, analysis applied with multi-variant statistics which relates various factors with prognosis also developed (12).

The purpose of this study was to establish mortality rates for medically and surgically treated colic and to identify potential prognostic indicators for mortality of equine colic in Korean.

Materials and Methods

The records of 119 horses admitted to the equine hospital of KRA (Korea Racing Authority), between January 2011 and December 2013 for treatment of colic were evaluated retrospectively. In present study, individual factors, physical factors, laboratory factors were included.

For individual factors, variables relating to the history and signalment of the horse (age, breed, sex, administration period date); for diagnosis and treatment of the colic (surgical or medical treatment, clinical and surgical diagnosis including location and type of lesion (large/small intestine, strangulating/non-strangulating) were extracted. The physical examination and laboratory findings on presentation to the KRA were recorded. They included the color of oral mucous (red, pink,

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pale), pain (mild, moderate, severe), intestinal motility (decrease, normal, increase), CRT (1sec, 2sec, 3sec \leq), rectal temperature, respiratory rate, heart rate, CBC (RBC, WBC, neutrophil, hemoglobin, PCV, platelet, fibrinogen), serum chemistry (TBIL, GGT, AST, ALP, CK, LDH, BUN, creatinin, glucose, uric acid), electrolytes and acid-base indicators (Ca, K, Na, Cl, Mg, anion gap, TCO₂, pH).

Blood collection and analysis

Blood was drawn aseptically from the jugular vein by using 10 ml safti syringe and 22-gauge needle (Becton Dickinson, Korea) and tested within 10 minutes.

Vetscan HM5 (Abaxis, California US) was used for CBC measurement. Serum chemistry was measured by Vetscan VS2 and Vet Scan Equine Profile Plus (Abaxis, California US). Anion gap was measured by Heska i-Stat (Heska, Colorado US).

Statistical methods

Initially, survivors and non-survivors were classified to compiled statistics. Measured value gained from research was presented with Mean \pm SD. The variables gender and breed distribution were tested using Chi-square (χ^2) or Fishers exact test, as were comparisons with other studies. All levels of significance were set to $P < 0.05$. In the cases of low cell-frequency, Fisher's exact test was used. Only when P-value being under 0.05 ($P < 0.05$), it was regarded as having significance. Besides that, we also investigated the incidence from individual factor. As the rest factors were considered to be continual and independent, we used T-test or Mann-Whitney test.

Results

The records of 119 horses remained for analysis. There was a total of 18 deaths, resulting in an overall mortality rate of 15%. Of the 119 records reviewed, 93 (78%) were treated medically and 26 (22%) surgically (Table 1).

Thirty-five colic horses out of 119 colic cases were diagnosed and short-term outcome was given (Table 2). Mortality rates in relation to location of lesions in the intestinal tract (large intestinal/small intestinal) and type of lesion (strangulating/non-strangulating) are listed (Table 3). The mortality rate in small intestinal lesion was 78% and strangulating lesion was 91%.

There was no association between mortality and 3 individual factors (age, period of admission, gender) in the present study (Table 4). High frequency rate was found in ≤ 3 years age (59%) and male (50%). Within physical factors (Table 5), color of mucous, pain, intestinal motility, rectal tempera-

Table 3. Mortality rates in relation with location of lesion and type of lesion

	Ratio (No. dead/total at risk)	Mortality rate (%)
Location of lesion		
Large intestinal lesion	8/21	38
Small intestinal lesion	7/9	78
Type of lesion		
Strangulating	10/11	91
Non-strangulating	3/11	27

Table 1. The number of dead case and short-term survival case for medically and surgically treated in 119 colic horses

	Medically treated cases	Surgically treated cases	Overall (Rate%)
Short-term survival cases	81	20	101(85)
Euthanized or dead cases	12	6	18(15)
Overall (Rate%)	93(78)	26(22)	119

Table 2. Diagnosis category and short-term outcome in 35 colic horses out of 119 colic cases

Diagnosis	N	Survival to discharge		Euthanized or dead before discharge	
		Medical	Surgical	Medical	Surgical
Large colon: Volvulus/intussusception /strangulation	6	-	2	2	2
Constipation colic	6	5	1	-	-
Small intestine: Volvulus/intussusception/strangulation	5	-	-	4	1
Large colon/caecum impaction	5	2	1	-	2
Large colon displacement	4	-	1	1	2
Spasmodic colic	3	2	1	-	-
Ruptured viscus	2	-	-	-	2
Small intestinal impaction	1	-	-	1	-
Colitis	1	-	1	-	-
Iliocecal block	1	-	-	-	1
Other	1	1	-	-	-
Totals	35	10	7	8	10

Table 4. The evaluation of individual factors

Variables	No. of observations		P-value	Rate(%)
	Survived group	Dead group		
Age(yrs)			0.37	
≤ 3	26	6		59
4~8	4	3		13
9 ≤	12	3		28
Period of admission			0.825	
Dec~Feb	8	3		19
Mar~May	12	5		29
Jun~Aug	14	4		31
Sep~Nov	11	2		22
Gender			0.772	
Male	20	6		50
Female	11	5		31
Gelding	8	2		19

Table 5. The evaluation of physical factors

Variables	Survived group	Dead group	P-value
Color of oral mucous			0.002*
red	7	1	
pink	13	0	
pale	5	7	
Pain			0.001*
mild	13	0	
moderate	13	1	
severe	8	12	
Intestinal motility			0.015*
hypo	10	9	
normal	7	2	
hyper	12	0	
CRT			0.2
1sec	10	2	
2sec	15	3	
3sec≤	3	3	
Rectal temperature(°C)	38.12 ± 0.60	38.67 ± 0.76	0.026*
Respiratory rate(/min)	22.44 ± 11.97	35.50 ± 23.20	0.116
Heart rate(/min)	46.78 ± 15.45	65.91 ± 20.46	0.001*

ture, heart rate were significantly different between dead group and survived group. Pale mucous color, severe pain, hypomotility in intestine, increased rectal temperature (38.67 ± 0.76) and heart rate (65.91 ± 20.46) showed poor prognosis. In CBC (Table 6), RBC (10.70 ± 2.79), hemoglobin (17.28 ± 4.44), PCV (49.02 ± 12.62) were significantly high in dead group in colic cases. Low platelet (121.27 ± 43.69) level was related to poor prognosis. Only CK (816.53 ± 129.08), LDH (601.50 ± 249.65), glucose (171.79 ± 65.33) of dead group was increased in enzyme indicators with significance (Table 7). There was no association between prognos-

Table 6. The evaluation of laboratory factors; CBC

Variables	Survived group	Dead group	P-value
RBC(10 ⁹ /L)	9.18 ± 2.21	10.70 ± 2.79	0.029*
WBC(10 ⁹ /L)	8.51 ± 2.47	9.29 ± 5.08	0.571
Neutrophil(10 ⁹ /L)	6.38 ± 2.83	7.20 ± 5.54	0.7
Hemoglobin(mg/dl)	14.30 ± 2.37	17.28 ± 4.44	0.02*
PCV(%)	38.79 ± 9.40	49.02 ± 12.62	0.001*
Platelet(10 ⁹ /L)	172.64 ± 72.21	121.27 ± 43.69	0.011*
fibrinogen(mg/dl)	477.42 ± 149.91	425.00 ± 128.17	0.371

Table 7. The evaluation of laboratory factors; enzymatic indicators

Variables	Survived group	Dead group	P-value
TBIL(mg/dl)	9.75 ± 39.43	5.26 ± 2.81	0.686
GGT(g/L)	38.24 ± 62.03	29.42 ± 13.09	0.643
AST(g/L)	400.99 ± 258.60	586.00 ± 355.96	0.102
ALP(U/L)	184.70 ± 66.31	318.25 ± 198.21	0.1
CK(U/L)	259.69 ± 182.09	816.53 ± 129.08	0.008*
LDH(U/L)	374.88 ± 194.65	601.50 ± 249.65	0.009*
BUN(mg/dl)	21.36 ± 25.56	21.70 ± 12.34	0.963
Creatinin(mg/dl)	1.34 ± 0.44	2.88 ± 3.73	0.203
Glucose(mg/dl)	121.61 ± 41.11	171.79 ± 65.33	0.015*
Uric acid(mg/dl)	0.60 ± 0.83	0.97 ± 0.59	0.269

Table 8. The evaluation of laboratory factors; electrolytes and acid-base indicators

Variables	Survived group	Dead group	P-value
Ca(mg/dl)	11.35 ± 0.90	11.01 ± 0.64	0.318
K(mmol/L)	4.50 ± 5.16	3.80 ± 0.82	0.615
Na(mmol/L)	135.04 ± 7.84	135.07 ± 3.29	0.989
Cl(mmol/L)	97.85 ± 6.34	94.00 ± 4.32	0.076
Mg(mmol/L)	1.60 ± 0.35	1.50 ± 0.34	0.449
Anion gap (mmol/L)	9.57 ± 33.23	1.23 ± 0.31	0.486
TCO ₂ (mmol/L)	28.56 ± 3.57	31.33 ± 1.53	0.095
pH	7.41 ± 0.04	7.42 ± 0.06	0.76

sis and electrolytes, acid-base indicators (Table 8).

Discussion

This study is the first to report the mortality rate from referral hospital in Korea. Colic cases are examined over a period of 3 years, retrospectively. Few data was missing reducing the power of difference. In this study, the mortality rates were short-term only and there was no follow-up cases despite 10-15% of colic cases reoccur in horses that have experienced colic previously (17).

At present, equine colic is approached by focusing on diagnosis and treatment (medically and surgically treated). The short-term survival rate (85%) for all colic cases in the present study is higher than other studies only similar to Ger-

many (84%). The probabilities of survival in surgically and medically colic cases (78 and 22%, respectively) also correspond to previous studies on Germany (3,8).

Diagnosis, localization and type of lesion were associated with prognosis. Horses suffering from a large intestinal disease had a lower mortality rate (38%) than those with a small intestinal disease (78%). Likewise, strangulating lesions (91%) had a higher mortality rate than non-strangulating lesions (27%). The mortality rate recorded in this study is higher than previous study obtained a 63% mortality rate for surgical small intestinal lesions and a 60% mortality rate in surgical cases with strangulating lesions (15).

Several factors that shown in Dukti *et al.* (2009) were included to predict prognosis and probability of survival after treatment. There were 3 individual factors (age, period of admission, sex). Among age factors, the young group (under 3years) has the highest frequency. This result is different from previous study where middle-age shows the highest frequency, but also there are some coincidences in that the female has the highest frequency (17).

Body temperature and heart rates have a significance for survival rate. It corresponds with common studies that high temperature means severe inflammatory condition. The degree of dehydration could be confirmed from rapid heart rate, weakened color of mucous membrane and increase of PCV. It shows better significance than other indicators ($P < 0.05$) and this can be used in a logistic regression model, offer a strong model for clinical assessment of prognosis (16). However, measuring color of mucous membrane and capillary refill time can be subjective therefore it needs to be supplemented (15).

Significantly high CK activities were found in dead group of the horses with colic. This finding might be the result of the presence of gastrointestinal lesions, hemolysis due to dehydration, increase in muscular activity, and muscular injury during prolonged transportation or rolling (13). Previous studies reported that hyperglycemia in the first 48 hours of hospitalization is associated with a worse prognosis for survival to discharge (7). Hyperglycemia is believed to be a consequence of dysregulation of glucose homeostasis.

DIC or bleeding can be the reasons of decreased platelet level in dead group (11). Several studies confirm that there was a significant association between thrombocytopenia and mortality as shown in present result (4). Despite the anion gap reported to a useful prognostic indicator (2), there was no significant difference between dead group and survived group in presented study. Hypocalcemia was of prognostic relevance in regard to survival of colic. Furthermore, correction of hypocalcemia improved clinical outcome (6). There were no significant group difference in blood pH. It is estimated that blood CO_2 of dead groups compensate pH.

The equine colic is a disease that brings entire body problem so it is mentioned that normally measured results are not surely the prognostic indicator (14,16). This research has the same tendency. Large-scale studies and using high-dimensional approaching statistical model are required for more accurate results on identifying prognostic factors.

Conclusion

1. The overall mortality rate was 18/119 (15%). Of the 119 records reviewed, 93 (78%) were treated medically and 26 (22%) surgically. The mortality rate in small intestinal lesion was 7/9 (78%) and strangulating lesion was 10/11 (91%).

2. The significance between individual factors and prognosis of equine colic was not valid but high frequency rate was found in ≤ 3 years age (59%) and Male (50%).

3. In dead group of physical factors, rectal temperature ($38.67 \pm 0.76^\circ\text{C}$) and heart rate (65.91 ± 20.46 times/min) were higher than those of survived group. The mortality rate was significantly high in the pale mucous membrane color and severe pain and decreased intestinal motility.

4. In laboratory factors, dead group of platelet ($121.27 \pm 43.69 \text{ } 10^9/\text{L}$) were lower than survival group, and had higher measures of RBC ($10.70 \pm 2.79 \text{ } 10^9/\text{L}$), hemoglobin ($17.28 \pm 4.44 \text{ } 10^9/\text{L}$), PCV ($49.02 \pm 12.62\%$) with significance ($P < 0.05$). Group with increased enzymatic activity of CK ($816.53 \pm 129.08 \text{ U/L}$), LDH ($601.50 \pm 249.65 \text{ U/L}$), glucose ($171.79 \pm 65.33 \text{ mg/dl}$) showed poor prognosis.

Acknowledgments

This research was supported by the 2014 scientific promotion program funded by Jeju National University.

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한국에서 산통마의 치명률과 예후인자의 회귀적 분석

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요 약 : 산통은 이환률과 치명률이 높아 말 산업에 가장 우려되는 질병이다. 많은 나라에는 산통마의 내과적, 외과적 치료에 따른 치명률과 예후인자 평가를 위한 연구 결과가 있지만 한국에서는 산통의 예후 판단을 위한 객관적 연구가 이루어지지 않았다. 본 논문에서 한국 산통마의 치명률을 확인하고, 잠재적 예후 인자들을 평가를 하고자 하였다. 2011년 1월부터 2013년 12월까지 한국마사회에 내원한 119마리의 산통마를 대상으로 조사하였다. 유의성을 평가하기 위하여 카이제곱검정, T-test와 Mann-Whitney test를 사용하였다. 그 결과, 전체 치명률은 15%였으며 내원한 산통마 중 78%가 내과적 치료를 받았다. 개체적 인자인 성별, 나이, 내원 시기는 예후와 유의성은 없었으나 3세 이하 (59%)의 수컷 (50%)에서 발생률이 높았다. 탈수의 대표적 지표인 구강점막의 색깔과 PCV는 생존집단과 폐사집단 사이에 유의적인 차이를 보였다. 그 외 신체적 인자인 심박수, 장운동성 그리고 직장온도도 예후와 유의적으로 관련이 있었다. 임상병리인자 중에는 적혈구수, 혈색소농도, 총진세포용적, 혈소판수, 크레아티닌아아제(CK), 젓산탈수소효소(LDH), 혈당치가 산통의 예후인자로서 통계적으로 유의성이 있음을 확인하였다.

주요어 : 산통마, 이환률, 치명률, 예후인자.