ANION GAP AS A PROGNOSTIC INDEX FOR COWS WITH ABOMASAL DISPLACEMENT AND CECAL DILATATION AND TORTION

Abomasum deplasmanlı ve sekum dilatasyonlu ve torsiyonlu
sığırlarda prognostik indeks olarak
Anyonik Gap

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Özet : Abomasum deplasmanlı ve sekum dilatasyonlu ve torsiyonlu toplam 66 vaka kayıtları, kalp vurum sayısı, plazma baz fazlalığı (BE), serum klorid (Cl^-) ve Anyonik gap (AG)'ın prognostik indeks olarak kullanılıp kullanılmayacağının belirlenmesi amacıyla incelendi. Sığırlar-da kalp vurum sayısı : $\geqslant 90$; BE:$>+7.5$,<-5; Cl^- :$\leqslant 88$ ve AG:>26 sınırlarına göre gruplandırıldı. En yüksek ölüm oranı % 73.3 ve % 52.63 ile sırasıyla AG ve Cl^- konsantrasyonunda gözlendi ($p < 0.05$). Operasyon öncesi AG'ın hesaplanmasının, abomasum deplasmanlı ve sekum dilatasyonlu ve torsiyonlu sütçü ineklerde prognostik indeks olarak güvenilir olduğu bulundu. Anyonik gap'ın, BE ve kalp vurum sayısından prognostik in-deks olarak çok daha güvenilir ve doğru bir indeks olduğu belirlendi. Cl^- konsantrasyonunun ise, ikinci bir kriter olarak kullanılabileceği so-nucuna varıldı.

Sumary : Case records of total 66 cows with abomasal displacement and cecal dilatation and torsion were examined to determine whethar the preoperative heart rate, plasma base excess (BE) concentration, serum chloride (Cl^-) and Anion gap (AG) could be used as a prognostic index. Cows were divided into groups according to the following ranges;

Heart rate $\geqslant 90$; BE:$>+7.5$, <-5; Cl^-: $\leqslant 88$; AG:>26. The higest dead rates were observed with 73.3 % and 52.63 % in AG and Cl^-, respectively ($p < 0.05$). It was found that preoperative calculation of AG could be reliably used and predict the outcome of abomasal displacement and cecal dilatation and torsion in dairy cattle. The AG was much more ac-

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curate index for predicting outcome than BE and heart rate. Cl^- concentration could be used as the second criterion.

Introduction

Surgical management of left displacement of abomasum (LDA), right displacement of abomasum (RDA), abomasal torsion (AT) and cecal dilatation and torsion (CDT) is the treatment of choice, but the survival rate decreases as the condition progresses. A preoperative index which accurately predicts the postsurgical outcome of LDA, RDA, AT and CDT in cattle would be useful in determining whether surgical correction is economically wise.

In a study of cattle with AT, the preoperative serum Cl^- concentration and preoperative heart rate were found to be useful as prognostic indicators. It has been pointed out that cattle in which the preoperative serum Cl^- concentration was 79 mEq/L or in which the heart rate was 100 beat/min. had a poor prognosis for survival (10). Hjartkjaer and Svendsen (4) found that as the total lactate activity increased, the survival rate decreased in the case of RDA and AT. In an another study, it was found that the survival rate of cows with AT decreased or the BE concentration decreased; the lowest survival rate was observed in cows with BE — 0.1 mEq/L (9).

Since the introduction by Gample in 1950 of the "Gamblegram" as a method of expressing the interrelationship of anions and cations, most physicians have become familiar with the concept that there exists a balance between these ions. In the common methods for expressing this balance, a difference between the anions and cations is generally present and this has been referred to as the "anion gap" (11, 14). The anion gap (AG) is customarily calculated as, AG: $(Na^+) + (K^+) — (Cl^-) + (HCO_3^-)$. Some calculation of the AG may ignore the concentration of K^+, since it is quite consistent and quite small. When K^+ is excluded, the formula for calculating the anion gap is as follows;

AG : $(Na^+) — (Cl^-) + (HCO_3^-)$ (2, 5, 8).

The anion gap in cattle is approximately 14 mEq/L when is calculated by the first formula.

This gap has been shown to have clinical and labarotory significance. There have been several recent brief reports (1, 6, 12) regarding to the clinical value of using AG in patient diagnosis and management in human medicine.

This study was designed to evaluate whether the calculated AG is suitable as a prognostic index in the cases of abomasal displacement and CDT, and to compare the use of AG with that of serum chloride concertration, BE and heart rate as prognostic indices.

Materials and Methods

Case records 20 cows with LDA, 18 cows with RDA, 18 cows with AT and 10 cows with CDT admitted to the Large Animals Internal Medicine Clinic, Faculty of Veterinary Medicine, University of Utrecht were rewieved. The cattle ranged in age from 1.5 years to 7 years. The breed of the all cows was Holstein Fresian.

The surgical treatment was applied to all cows. Survival was defined as recovery of the patient to the point of being discharged from the clinic to the owner. Deaths occuring, due to various causes while the cows were hospitalized were tabulated. The deaths beyond this occuring after discharge, as well as deaths due to slaughter for failure to return to production. Shortly after admission to the clinic, sistemic clinical examination was done and the blood samples were collected from jugular vein directly into a heparinized (Thromboliquine R, Organon Tecnica, 0.2 mg/ml blood) syring. The samples were transported immediately to the laborotory for pH and blood gas analyser(*). The plasma BE and HCO_3^- concentrations were calculated using Siggard-Anderson normogram.

In the mean time, blood sample was collected from jugular vein for the determination of serum Na^+, K^+ and Cl^- concentrations. Serum Na^+ and K^+ concentrations were measured Flamephotometrically (**). Serum Cl^- concentration was measured electrometrically (***).

Cows were divided into groups according to the following ranges;

Heart rate (beat/min) : $\geqslant 90$; BE (mEq/L): $>+7.5, <-5$; Cl^- (mEq/L)

$\leqslant 88$; AG (mEq/L): >26 Accuracy of preoperative heart rate, BE, Cl^- and AG values in predicting the outcome of abomasal displacement and CDT cases were evaluated using student t test. Correlation within these predictive indices was calculated (3).

(*)   ABL, 330 Radiometer, Copenhagen, Denmark.

(**)   Model 243 Instrument Labarotory Inc. Lexington, M. A.

(***)   Chlor-o-Counter, Marius.

Results

During the hospitalization, 5 cows with RDA and 8 cows with AT died after surgical medication, while death did not occur in any case of LDA and CDT.

The number of instances and outcome in different ranges of heart rate, BE, Cl⁻ and AG are shown in table 1. The major discrepancy between observed and expected survival was for cows with heart rate :

$$\geqslant 90; \ BE:>+7.5, \ <-5; \ Cl^-:\leqslant 88 \text{ and } AG:>26$$

The number of instances, outcome, death rate and survival rate in the above range of heart rate, BE, Cl⁻ and AG are shown in Table 2. The highest death rates were observed with 73.33 % and 52.63 % in AG and Cl⁻, respectively. t values obtained from different predictive indices are shown in Table 3. A statistically significant negative linear correlation (r : -0.62) existed (p < 0.01) between AG and serum chloride (Table 4).

AG was found to be significantly different from heart rate and BE (p < 0.05), while Cl⁻ was not significantly different from heart rate and BE (p > 0.05). There was no difference between AG and Cl⁻ (p > 0.05).

Discussion

The present study revealed that LDA and CDT were not lifethreating conditions. Because acid - base and fluid - electrolyte disturbances do not commonly develop in these conditions (13). In this study, the highest AG values in LDA and CDT were found to be 23.7 and 24.6 respectively. So death did not occur in any case of LDA and CDT.

Cattle with RDA and AT typically develop metabolic alkalosis due to the sequestration of abomasal secreations rich in HCl. These cows are hypochloremic and have a high BE concentration. However in cattle with severe and prolonged AT, these appears to be overriding metabolic acidosis with a low BE concentration (4). This can be classified as a mixed primary acid - base disturbance (7) in which an increasingly severe metabolic acidosis, because superimposed, on the existing metabolic alkalosis late in the course of the condition.

The metabolic acidosis is probably caused by severe dehydration and associated with hypovolemia and decreased tissue perfusion. In addition, the post mortem evidence of abomasal wall necrosis in many of these cows indicates that the severe distention and twisting of the abomasum and associated with viscera are likely have to caused occlusion of the

Table 1. The number of instances and outcome in different ranges of Heart rate, Base excess, Chlor concentrations and Anion gap.

	Ranges	The number of instances	Died	Survival
Heart Rate	120 — 90	30	11 (7 AT, 4 RDA)	19
	89 — 79	23	2 (1 AT, 1 RDA)	21
	78 — 60	13	—	—
Base excess	(+24) — (+7.5)	20	7 (4 AT, 3 RDA)	13
	(+7.4) — (—4.9)	38	2 (RDA)	36
	(—13.1) — (—5)	8	4 (AT)	4
Chlor	119 — 101	24	—	24
	100 — 89	23	3 (2 AT, 1 RDA)	20
	88 — 53	19	10 (6 AT, 4 RDA)	9
Anion gap	55.4 — 26	15	11 (8 AT, 3 RDA)	4
	25.9 — 20	25	2 (RDA)	23
	19.9 — 9.3	26	—	26

vascular supply to these organs. This would result in an increase in anaerobic metabolism with the occumulation of lactate and other organic acids in the bloodbuffer systems and cause a decrease in BE concantration (4).

In this study, 5 cows with RDA died during hospitalization. 3 of them had metabolic alkalosis and the another 2 cows had a normal acid-base status. The lowest and the highest value of the AG in these cows were 21.2 and 30.3, respectively. 8 cows with AT died during hospitalization. 5 of them had metabolic acidosis and the another 3 cows had metabolic alkalosis. The lowest and highest value of AG in these cows were 33.4 and 55.4 respectively.

It is well known that metabolic acidosis, dehydration, therapy with sodium salts of strong acids, therapy with certain antibiotics and metabolic alkalosis cause elevated AG (2). Accumulation of organic or inorganic acids in the extracellular space cause changes in the serum HCO_3^- concentration and in the AG (2). However, it has been reported that metabolic alkalosis can cause 3 or 5 mEq increasi in AG (2, 11). Smithline and

Table 2. The number of instances, outcome, death rate and survival rate in the accepted predictive indices of Heart rate (HR), Base excess (BE), Chlor (Cl) and Anion gap (AG).

Remarks	Ranges	The number of instances	Outcome Died	Outcome Survival	Death rate (%)	Survival rate (%)
HR	$\geqslant 90$	30	11 (7 AT, 4 RDA)	19	36.67 b	63.33
BE	$>+7.5, <-5$	28	11 (8 AT, 3 RDA)	17	39.29 b	60.71
Cl	$\leqslant 88$	19	10 (6 AT, 4 RDA)	9	52.63 a b	47.37
AG	>26	15	11 (8 AT, 3 RDA)	4	73.33 a	26.67

Values in which the same order and has different letter was found to be different.

Table 3. Values obtained from different predictive indices.

	HR	BE	Cl
AG	2.543^x	2.318^x	1.280$^-$
Cl	1.105$^-$	0.907$^-$	
BE	0.205$^-$		

^{x} ; p < 0.05
$^-$; p > 0.05

Table 4. Correlation values within HR, BE, Cl and AG.

	HR	BE	Cl
AG	0.27^x	—0.19$^-$	—0.62^{xx}
Cl	—0.20$^-$	—0.51^{xx}	
BE	—0.09$^-$		

^{x} ; p < 0.05
^{xx} ; p < 0.01
$^-$; p > 0.05

Gardner (11) stated that the reason of this increment is unknown. Whereas, Emmett and Narins (2) stated that this increment attributable to an increase in plasma lactate. Because a rise in pH stimulates the net production of lactic acid by many tissue.

Although Simpson et al (9) has stated that cattle in which the preoperative BE was < — 0.1 had a poor prognosis for survival .In this study, 11 cows (8 AT, 3 RDA) died when BE ranges : > + 7.5, < — 5 were taken as a prognostic index (p < 0.05). Smith (10) pointed out that cattle with AT had presurgical Cl$^-$ concentration < 79 mEq/L or heart rate 100 minute had poor prognosis. In this study, heart rate was also not found as a prognostic index (p > 0.05), while Cl$^-$ concentration : < 88 mEq/L and AG : > 26 were found as a reliable prognostic index (p < 0.05). But, AG seemed to be more reliable as a prognostic index, because of high death rate (73.33 %). However Cl$^-$ concentration can be used as the second criterion to determine whether a cow with abomasal displacement and CDT should be treated or euthanatized.

In conclusion, it vas found that preoperative calculation of AG could be reliably used as a prediction for the outcome of abomasal displacement and CDT in dairy cattle. The AG was a much more accurate index for

predicting the outcome than BE or heart rate. Cl⁻ concentration can be used as the second criterion.

Acknowledgement

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