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Original Contribution

BASE EXCESS/DEFICIT LEVELS IN PATIENTS WITH INTRA-ABDOMINAL HYPERTENSION

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ABSTRACT

Intra-abdominal pressure (IAP) is a harbinger of intra-abdominal mischief, and its measurement is cheap, simple to perform, and reproducible. Intra-abdominal hypertension (IAH), especially grades 3 and 4 (IAP>20 mmHg), occurs in over a third of patients and is associated with an increase in intra-abdominal sepsis, bleeding, renal failure, and death. IAH has adverse effects on cardiovascular, respiratory, renal, gastrointestinal and neurological function. IAH and abdominal compartment syndrome are associated with significant morbidity and mortality. The reduction of IAP is a cornerstone of breaking the series of pathophysiological changes that triggered others, and resulting in a poor outcome for the patients.

The two most commonly used markers in assessing resuscitation remain base deficit and lactate. A significant base deficit has been a marker of mortality in many studies.

The aim of this study is to identify the base excess (BE)/ base deficit (BD) levels in patients with intra-abdominal hypertension.

Materials and methods: prospective study for the period from March 2011 to June 2012 on 44 patients aged >18 years undergoing major abdominal surgery and hospitalized for more than 72 hours in the intensive care unit of University Hospital in Stara Zagora. Demographic characteristics: N=44, age 65 ± 5.2 years, Gender (male / female): 33/10; BMI = 26.6 ± 3.5 kg/m²; SOFA score 6.1±2.6. Patients were divided into 4 groups according to the value of IAP and WSACS guidelines - group A - normotensive with IAP up to 11 mmHg, group B with IAP from 12 to 15 mmHg, group C with a pressure of 16 to 20 mmHg, and Group D with IAP from 20 to 25 mmHg. The base excess (BE)/ base deficit (BD) levels were tested whit blood – gas analyzer „ABL basic 800" – Radiometer and Siemens Rapidpoint 350.

Results: The obtained data were processed statistically, using level of significance P<0.05. Analysis of the results showed that patients with second and third degree abdominal hypertension have significantly higher BD levels.

Conclusion: Significantly higher levels of BD in patients with high IAH correlate with the severity of pathophysiological changes and may serve as a marker for the extent of the damage to come.

Key words: abdominal compartment syndrome, intra-abdominal pressure

INTRODUCTION

Intra-abdominal hypertension (IAH) during ICU period is an independent risk factor for death. The pathophysiological effects of raised intra-abdominal pressure include reduced venous return and decreased cardiac output, decreased lung compliance and increased airway pressure, alterations in renal blood flow resulting in a reduced glomerular filtration rate, and impaired blood flow to all abdominal organs. A pathological increase in IAP has negative effects on the splanchnic, respiratory, cardiovascular, renal and neurological function. Intra-abdominal

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hypertension (IAH), especially grades 3 and 4 (IAP>20 mmHg), occurs in over a third of patients and is associated with an increased risk of intra-abdominal sepsis, bleeding, renal failure, and death. IAH and abdominal compartment syndrome are associated with significant morbidity and mortality(1-7).

The reduction of IAP is a cornerstone of breaking the series of pathophysiological changes that trigger other harmful effects which result in a poor outcome for the patients

The two most commonly used markers in assessing resuscitation remain base deficit and lactate. A significant base deficit has been a marker of mortality in many studies (8-12).

The aim of this study is to identify the base excess (BE) / base deficit (BD) levels in patients with intra-abdominal hypertension.

MATERIALS AND METHODS

Prospective study for the period from March 2011 to June 2012 on 44 patients aged >18 years undergoing major abdominal surgery **(Table 1)** and hospitalized for more than 72 hours in the intensive care unit of University Hospital in Stara Zagora. Demographic characteristics: N=44, age 65 ± 5.2 years, Gender (male / female): 33/11; BMI = 26.6 ± 3.5 kg/m²; SOFA score 6.1±2.6. Patients were divided into 4 groups according to the value of IAP and World Society of the Abdominal Compartment Syndrome (WSACS) guidelines - group A - normotensive with IAP up to 11 mmHg, group B with IAP from 12 to 15 mmHg, group C with a pressure of 16 to 20 mmHg, and group D with IAP from 20 to 25 mmHg. A blood-gas analyzers „ABL basic 800" – Radiometer and Siemens Rapidpoint 350 were used to measure the base excess/base deficit.

Table 1. *Surgical causes*

Elective	n	Emergency	n
Upper gastrointestinal surgery	16	Acute pancreatitis	3
Lower gastrointestinal surgery	7	Perforated abdominal viscus	5
Abdominal aortic aneurysm repair	2	Intestinal obstruction	10
		Abdominal aortic aneurysm repair	1

The IAP was measured via indwelling Foley bladder catheter, according to a standardized technique. The IAP was always measured at end-expiration in the complete supine position and stable conditions. The transducer was nullified at the level of the mid-axillary line. We used closed system for measurement of bladder pressure. A self-prepared set was used, it is consisted of three stopcocks, first connected with pressure line via connector to Foley catheter and 50 ml syringe, a bag of 0.9% NaCl 500 ml attached to the second stopcock, and the third stopcock is connected to transducer dome. The system is flushed to remove the air. Oscillation test and respiratory pressure variation was used to confirm the proper functioning of the system. 20 ml of 0.9% NaCl was administrated and after period of 2 minutes the value on the monitor was registered. For each patient a series of 3 measurements at 10 minutes intervals was recorded and mean values were used for statistical analysis. All measurements were performed at 8 hours intervals for 48 hours by the same observer. Meanwhile in the same time interval blood samples were taken from radial artery by puncture or through indwelling arterial catheter.

We analyzed the mean values of BE/BD during the first 24 hours and during the second 24 hours in this patients population stratified into 4 groups according to the values of the intra-abdominal pressure **(Table 2, Figure 1).** For data processing the following methods were used: D'Agostino & Pearson omnibus normality test; Pearson correlation coefficient; one way ANOVA & Dunnett's Multiple Comparison Test, with level of significance P value < 0.05.

RESULTS

Analysis of the results showed that patients with second and third degree abdominal hypertension have significantly higher BD levels.

The results of the parametric analysis (one-way analysis of variance) of the obtained values of BE/BD in the four groups of patients stratified according to the level of intra-abdominal hypertension are presented in tables 3 and 4 and

in the graphs in **Figure 2 and 3**. From the performed post-hoc Dunnett's multiple comparison test is evident that there is a significant difference in the values of BE / BD between patients without intra-abdominal hypertension and those of group D, in the first 24 hours, and the presence of such difference, in patients from group C and group D for the second 24 hours.

Table 2. *Descriptive statistics showing the measured values as mean, median, deviation, and D'Agostino & Pearson normality test of the distribution of measured values of BE/BD in the studied groups.*

	Group A	**Group A**	**Group B**	**Group B**	**Group C**	**Group C**	**Group D**	**Group D**
	First 24h	Second 24h	First 24h	Second 24h	First 24h	Second 24h	First 24h	Second 24h
Number of values	n =11	n =11	n =11	n =11	n =11	n =11	n =11	n =11
Minimum	-6,000	-3,600	-6,100	-2,200	-12,20	-13,20	-24,40	-20,40
25% Percentile	-3,300	-1,200	-3,100	0,1000	-6,100	-7,800	-13,50	-15,30
Median	0,5000	1,300	0,5000	1,300	-3,600	-3,600	-8,300	-9,200
75% Percentile	1,500	2,200	2,100	2,100	-2,100	-3,100	-5,500	-7,100
Maximum	2,100	2,600	2,300	2,200	2,400	0,9000	-2,600	-5,400
Mean	-0,9273	0,7000	-0,5091	0,7182	-3,727	-4,600	-10,60	-10,77
Std. Deviation	2,809	1,923	2,941	1,470	3,973	4,038	7,283	4,998
Std. Error	0,8470	0,5798	0,8866	0,4433	1,198	1,218	2,196	1,507
Lower 95% CI of mean	-2,815	-0,5919	-2,485	-0,2695	-6,397	-7,313	-15,49	-14,13
Upper 95% CI of mean	0,9600	1,992	1,466	1,706	-1,058	-1,887	-5,707	-7,415
D'Agostino & Pearson normality test								
K2	1,877	4,840	1,723	2,139	1,854	2,095	2,517	1,647
P value	0,3913	0,0889	0,4225	0,3432	0,3958	0,3509	0,2841	0,4389
Passed normality Test (alpha=0.05)?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
P value summary	ns	ns	ns	ns	ns	ns	ns	ns
Coefficient of variation	302.96%	274.72%	577.61%	204.72%	106.60%	87.78%	68.71%	46.40%
Skewness	-0,5609	-1,305	-0,8208	-0,9408	-0,4951	-0,7248	-1,022	-0,8267
Kurtosis	-1,189	1,142	-0,5893	0,03260	1,330	0,9779	0,09096	-0,3813
Sum	-10,20	7,700	-5,600	7,900	-41,00	-50,60	-116,6	-118,5

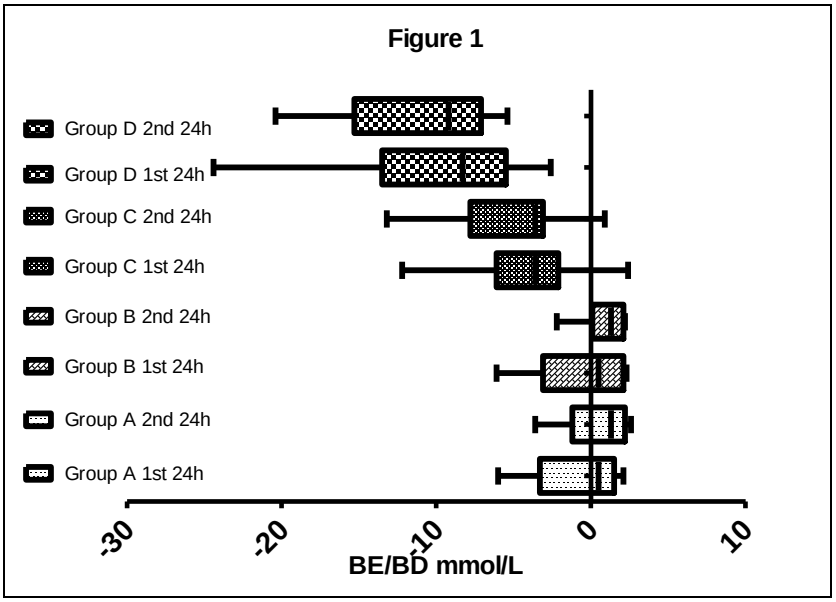

Figure 1. Values of BE/BD in the four groups of patients during the first and second day as mean, median, and SD.

Table 3. *Ordinary One way ANOVA analysis of the recorded values of the BE/BD in the 4 groups of patients with varying degrees of IAH, with post hoc Dunnett's test, for comparison of the results obtained in the first 24 hours among patients with and without intra-abdominal hypertension*

One-way analysis of variance					
P value	< 0.0001				
P value summary	***				
Are means signif. different? (P < 0.05)			Yes		
Number of groups	4				
F	11,21				
R squared	0,4567				
Bartlett's test for equal variances					
Bartlett's statistic (corrected)	12,38				
P value	0,0062				
P value summary	**				
Do the variances differ signif. (P < 0.05)			Yes		
ANOVA Table	SS	df	MS		
Treatment (between columns)		717,7	3	239,2	
Residual (within columns)		853,7	40	21,34	
Total	1571	43			
Dunnett's Multiple Comparison Test	Mean Diff.	q	Significant? P < 0.05?	Summary	95% CI of diff
Group A vs Group B	-0,4182	0,2123	No	ns	-5.228 to 4.391
Group A vs Group C	2,800	1,421	No	ns	-2.010 to 7.610
Group A vs Group D	9,673	4,910	Yes	***	4.863 to 14.48

*** P value–extremely significant (<0.001); ** P value–very significant (0.001-0.01); * P value-significant (>0.05); ns P value not significant (>0.05)

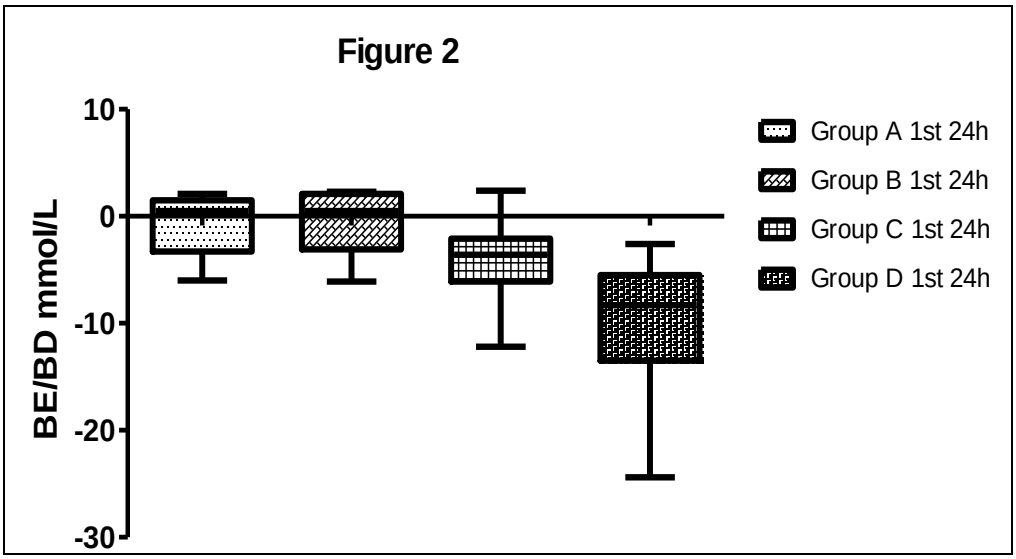

Figure 2. Box and whiskers plot– showing the values of BE / BD expressed as mean and SD in patients studied during the first 24 hours.

Table 4. *Ordinary One way ANOVA analysis of the recorded values of the BE/BD in the 4 groups of patients with varying degrees of IAH, with post hoc Dunnett's test, for comparison of the results obtained in the second 24 hours among patients with and without intra-abdominal hypertension*

One-way analysis of variance					
P value	< 0.0001				
P value summary	***				
Are means signif. different? (P < 0.05)			Yes		
Number of groups	4				
F	27,85				
R squared	0,6763				
Bartlett's test for equal variances					
Bartlett's statistic (corrected)	17,08				
P value	0,0007				
P value summary	***				
Do the variances differ signif. (P < 0.05)			Yes		
ANOVA Table	SS	df	MS		
Treatment (between columns)	984,9	3	328,3		
Residual (within columns)	471,5	40	11,79		
Total	1456	43			
Dunnett's Multiple Comparison Test	Mean Diff.	q	Significant? P < 0.05?	Summary	95% CI of diff
Group A vs Group B	-0,01818	0,01242	No	ns	-3.592 to 3.556
Group A vs Group C	5,300	3,620	Yes	**	1.726 to 8.874
Group A vs Group D	11,47	7,837	Yes	***	7.899 to 15.05

*** P value–extremely significant (<0.001); ** P value–very significant (0.001-0.01); * P value-significant (>0.05); ns P value not significant (>0.05)

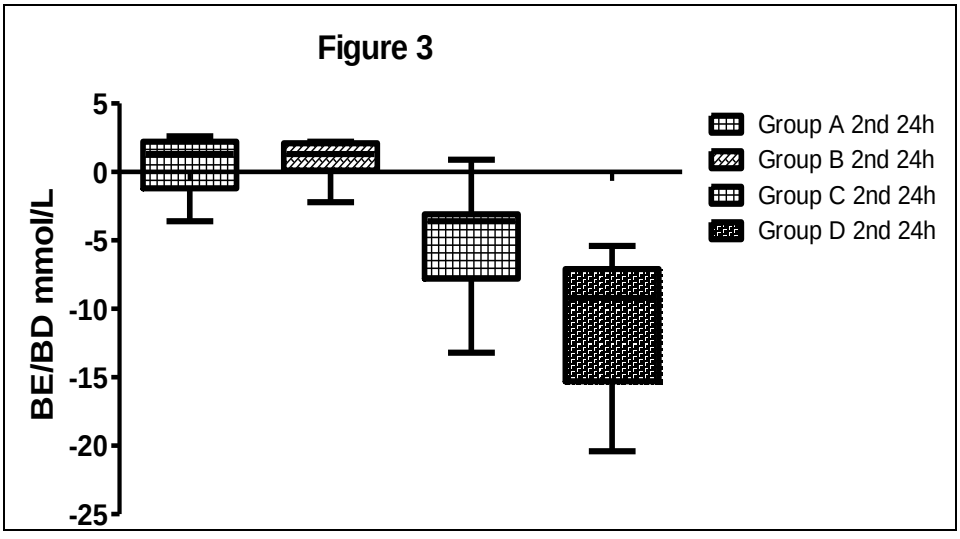

Figure 3. Box and whiskers plot– showing the values of BE / BD expressed as mean and SD in the studied patients during the second 24 hours.

CONCLUSION

The significantly higher levels of BD in patients with high IAH correlate with the severity of pathophysiological changes and may serve as a marker for the extent of the damage to come.

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