COMPARISON OF ACID-BASE BALANCE CHANGE IN HYPOVOLEMIC SHOCK WITH 0.9% NORMAL SALINE THERAPY AND RINGER'S LACTATE. A CONTROLLED RANDOMIZED CLINICAL TEST

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ABSTRACT

Background: Normal saline is often use in shock therapy if Ringer's lactate is not available. Some studies reported hyperchloremic acidosis associated with the use of normal saline in shock therapy. Objective: The goal of this study is to know the effect of normal saline compared with Ringer's lactate in therapy of hypovlemic shock. Method: This study was carried out in Dept of Pediatric Dr. Soetomo Hospital Surabaya between July - October 2006. The study population was children with hypovolemic shock age between 3 month-12 year old. Study design: double blind Randomized Controlled Trial. Result: 33 children with hypovolemic shock was included in this study, 16 children was treated with normal saline and 17 in Ringer's lactate group. There was no significant difference between group in initial data (p>0,05). There were no significant changes of SID, pCO2 and pH before and after treatment of Ringer's lactate group. While in normal saline group there was a significant change in SID before and after treatment (p=0.030). There was a significant difference in SID changes before and after treatment between normal saline and Ringer's lactate groups (p=0.010). There was also a significant increased of chloride in normal saline group before and after treatment (p= 0.026), although there was no hyperchloremic acidosis was found in this study. Conclusion: Normal saline therapy in hypovolemic shock may cause changes in SID although there was significant change in pH. There was no hyperchloremic acidosis found during this study maybe because of only small volume of normal saline was given.

Keyword: *Normal saline, hypovolemic shock, strong ion difference.*

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INTRODUCTION

Hypovolemic shock is still a considerable problem, with high morbidity and mortality is high. Fluid resuscitation is an important part in the management of the patient, because adequate fluid resuscitation is essential to maintain hemodynamics and organ and tissue perfusion (Pallazo 2001, Kellum 2002, Ichai & Levraunt 2003, Devlin & Barletta 2005, Martin 2001). Cystalloid fluids such as Ringer's lactate and physiological salt is first choice for patients with hypovolemic shock. In North America 0.9% NaCl is the fluid which are widely used, but there are limited usage due to the increase in plasma chloride levels. After treatment with the physiological salt, when administered in an amount of 30-50cc/kg hyperchloremia can cause acidosis. The occurrence of acidosis can be explained simply by Henderson-Hasselbach equation with an explanation through the dilution of plasma bicarbonate dilution is responsible for decrease of pH value, but according to Stewart because of the occurrence of acidosis hyperchloremic increased chloride caused a decrease in SID values that resulted in acidosis (Kellum 2002, Ichai & Levraunt 2003).

In Indonesia, physiological salt solution which is still a top choice for fluid resuscitation in hypovolemic shock, particulary in areas where other crystalloid fluids can not be found, although the various studies in other countries hyperchloremia acidosis was found after administration of physiologic salt, so that these fluids are still necessary think about safety when given to children with a state of hypovolemic shock. The aim is to see the effects of normal saline and Ringer lactate in hypovolemic shock to changes in acid-base balance.

MATERIALS AND METHODS

This research was conducted with a randomized controlled clinical trials of all patient double blind children aged 3 months - 12 years with a diagnosis of hypovolemic shock at Dr Soetomo Hospital, Exclusion criteria neonates, cardiac abnormalities, kidney, patients

with shock than hypovolemic shock , diabetes mellitus, pneumonia, toxic (ethanol, methanol, sasilat) and referral patients who had received shock treatment of hypovolemia. Have received airworthiness of ethics of the local ethics committee and were approved by the family.

Randomization was performed with consecutive sampling sample, followed by arterial blood sampling, for the examination of blood gas analysis and lactate. Blood Gas Analysis Blood Gas Analyzer inspected by Nova Biomedical pHoxplus 1620, and lactate with lactate Accutrend Roche typ.3012522 series. NR.00126886/473. Venous blood samples for complete blood count, with the Beckman instrument Coulter.GDA, BUN/serum creatinine, SGOT and SGPT, sodium, potassium and chloride, and albumin using a Beckman Coulter Synchron CX5.

Resuscitation using physiological salt solution or Ringer's lactate, after the administration of fluids 20cc/kg re-examination of blood gas analysis, sodium, potassium, chloride lactate. Statistical analysis was done by descriptive statistics for baseline data (mean value, standard deviation) and chi-square test of two independent samples t test,. Mann Whitney, two-sample t-test in pairs.

RESULTS

There are 33 samples can be evaluated and analyzed, ie each of 16 patients with physiologic salt group and 17 patients in the group of Ringer's lactate. Table 1 shows that there is no significant difference between the initial data on physiologic salt groups and Ringer's lactate group ($p > 0.05$).

Table 1. Sample Characteristics

No	Variables	Normal Saline 0.9% Mean (SD)	Ringer's Lactate Mean (SD)	*p*
1.	Age (month)	52 (46.01)	45 (46.12)	.69
2.	% IBW	86.37 (19.00)	99.00 (20.52)	.52
3.	Blood Pressure			
	Systolic	82.86 (13.8)	81.67 (18.01)	.88
	Diastolic	70 (8.16)	68.13 (17.31)	.88
4.	Pulse	143.67 (25.24)	143.93 (18.34)	.97
5.	Respiratory Rate	44.63 (15.03)	39.35 (15.59)	.33
6.	Laboratory			
	a) Hemoglobin	13.69 (2.24)	12.96 (2.39)	.37
	b) Leucocyte	12.781.25 (9439.22)	12.221.76 (9072.96)	.86
	c) Thrombocyte	255062.5 (208617.5)	288117.65 (230221.5)	.67
	d) Hematocrit	41.13 (7.38)	39.21 (6.76)	.44
	e) Rand. Blood Glc.	125.56 (31.57)	133.47 (47.98)	.58
	f) BUN			
	g) S. creatinin	25.18 (20.4)	23.5 (14.68)	.79
	h) SGOT	0.8744 (0.45)	0.9129 (0.41)	.80
	i) SGPT	79.58 (83.4)	83.12 (64.94)	.89
	j) Albumin	35 (25.4)	37.18 (26.11)	.89
		3.77 (0.51)	3.62 (0.43)	.31
7.	Sex			
	Male	6/ 16 (37.5%)	9/ 17 (52.9%)	.49

Significant difference in $p < 0.05$

Table 2. Changes in the Strong Ion Difference. PCO2 and pH in physiological salt groups and Ringer lactate after treatment

Variables	Normal Saline n = 16		Ringer's Lactate n = 17	
	Mean (SD)	*p*	Mean (SD)	*p*
Δ SID	4.18 (6.99)	.030*	-1.92 (5.70)	.185
Δ pCO2	1.12 (7.32)	.548	0.017 (5.95)	.990
Δ pH	-.038 (0.08)	.078	0.02 (0.89)	.352

* Differences significant at p value <0.05

Table 3. Strong Ion Difference difference changes, PCO2, pH, serum electrolytes and lactate at physiological salt groups and Ringer lactate after treatment

Variables	Normal Saline 0.9% n =16			Ringer's Lactate n =17			*p*
	Before Mean (SD)	After Mean (SD)	Difference (Δ) Mean (SD)	Before Mean (SD)	After Mean (SD)	Difference (Δ) Mean (SD)	
Natrium	133.82 (10.59)	133.51 (10.6)	0.306 (7.27)	133.52 (12.79	134.65 (8.22)	-1.135 (8.16)	.597
Potassium	4.37 (0.95)	3.65 (0.76)	0.722 (0.83)	4.01 (1.40)	4.01 (1.40)	0.294 (1.09)	.217
Chloride	106.82 (12.87)	110.50(12.88)	-4.362 (5.09)	108.46 (12.92)	108.64(10.37)	-0.182 (5.19)	.026*
Lactate	5.82 (1.48)	4.22 (1.45)	1.156 (0.79)	5.13 (1.35)	3.87 (0.95)	1.258 (0.83)	.720
SID	26.65 (7.59)	22.47 (6.45)	- 4.18 (6.99)	23.94 (9.28)	25.85 (9.20)	1.91 (5.70)	.010*
pCO2	21.34 (8.32)	20.21 (5.89)	- 1.12 (7.32)	20.43 (7.83)	20.41 (6.42)	- 0.01 (5.95)	.636
pH	7.30(0.155)	7.34 (0.147)	0.03 (0.080)	7.36 (0.181)	7.34 (0.158)	-0.20 (0.089)	.056

* Differences significant at p value <0.05

DISCUSSION

Physiologic salt as shock therapy is a liquid that is widely used in the United States, still got the loss with an increase in plasma chloride concentration, so that the liquid used alternative. Provision of physiological salt solution as shock therapy, if given in the amount 30-50cc/kg hyperchloremia will can cause acidosis. In the study of shock due to bleeding in animal experiments turned out to give a good response after administration of Ringer's lactate as compared with physiological salt (Kellum 2002, Latief 2005, Allison & Lobo 2000). In Indonesia, normal saline are still widely used in hypovolaemia shock therapy as a substitute Ringer lactate when the liquid is not obtained.

This research was conducted to see the difference in acid-base balance changes that occur after administration of physiological salt solution and Ringer's lactate. In this study after the administration of physiologic salt changes on the value of SID, but no changes in PCO2 and pH values. Significant changes in

SID indicates that the physiological salt that is fluid unbalance, because it contains chloride 154 mEq/L, higher than plasma chloride levels and to maintain neutrality, the electrons will affect the value of the SID. Being in the group of Ringer's lactate containing chloride 109 mEq/L is the fluid balance showed no change in the value of SID, PCO2 and pH. Significant changes in SID are supported with a significant difference in changes in chloride values between the groups with Ringer lactate normal saline.

Scheingraber et al in 1999, in his research on the content of patients with surgery, it turns out the group received physiological salt 30cc/kgbw/hour with a total of approximately 6000 ml of fluid, occurs hyperchloremia acidosis with decreasing pH, elevated levels of chloride and a significant decrease in SID. While the group after the administration of Ringer's lactate solution, showed no increase in chloride and a significant decrease in SID (Kellum 2002, Allison & Lobo 2000, Scheingraber et al. 1999).

Giving physiologic salt in this study there was a change in the value of the SID but no significant impact on changes in acid-base balance (pH). PH values between the two groups did not differ significantly, there are several possibilities, among others, the first existence of compensatory mechanisms of the body against acidosis that occurs, the second is the amount of fluid given is not too much like that reported in previous studies, because the average fluid given in this study 20 cc/kg was enough to improve patient hemodynamics. Ichai in his writings mentions that hyperchloremic metabolic acidosis that is currently or temporarily in patients who received preoperative fluid resuscitation, because of the limited amount of fluid delivery occurs unbalance or chloride excretion in patients with normal renal function (Kellum 2002)

In his research, et al Skellett of 5 patients with septic shock who received large amounts of physiological salt (40cc/kg/jam) there was an increase of chloride in plasma and acidosis occurs hyperchloremic significantly related to the decline in value of the SID but not significant in the concentration of lactate and anion that can not be measured (Skellett et al. 2000).
Research conducted on animals to compare giving Kellum 2002 Ringer lactate, normal saline and hextend (HES 6% with sodium level 143 mEq/L and chloride 124 mEq/L), apparently to providing normal saline, there are significant changes in PCO2 and SID compared with baseline and with group hextend (Kellum 2002)

Significant difference and chloride SID changes before and after treatment at physiological salt group and the group of Ringer's lactate. No significant difference in changes in PCO2 and pH and levels of potassium, sodium and lactate before and after treatment between the two groups. From these data can be seen that administration of different fluids will give effect to the change in SID value and chloride concentration.

Wilkes et al in 1999 in his study in patients after surgery which is expected to lose more than 500 cc of blood, there was a significant increase in chloride in physiologic salt groups and hespan (chloride = 114 (4.9) mmol/L compared with group receiving Hextend and Ringer lactate (chloride = 108 (Ichai & Levraunt 2003, Devlin & Barletta 2005) mmol/L. There is a significant increase in lactate levels and acidosis hyperchloremic occurred at physiologic salt groups and hespan. hespan Liquids are contained 6% HES with a sodium level 154 mEq/L chloride and 154 mEq/L12

Kushartono, on research to get any Significant correlation between the SID on serum lactate, or sodium chloride but not significant in the potassium (Kushartono 2005). In this study, there was a significant difference between the two groups of chloride changes. Morfei, 1999 states that by knowing the value of SID, the changes in H + can be explained by two mechanisms common: the first is the change of water concentration, the second if the sodium level is normal, changes in levels of ions are strong will also change the value of SID, particularly levels of chloride compared to levels other strong ions such as potassium, calcium and magnesium (Morfei 1999).

Alston, 2004 stating that there was a significant correlation between changes in [H +] and a number of electrolytes at different intravascular fluids, but can not explain in detail because other factors could influence the types of anesthesia and the average amount of fluid given. There was no significant correlation between lactate levels in the SID. This suggests that the metabolic acidosis that occurs during cardiopulmonary bypass surgery due to the decrease in SIDS compared with hypoperfusion conditions, lactate levels and haemodilution conditions (Alston et al. 2004).

CONCLUSION

The conclusion of this research is the provision of physiological salt on hypovolemic shock will affect the change in SID values, but does not affect the value of PCO2 and pH. This might be physiological salt solution given is not enough to cause the occurrence of acidosis hyperchloremic, and there are differences in changes in the value of the SID and chloride between the two groups. It is suggested to consider giving physiological

salt on hypovolemic shock with a total of more than 20 cc/kg.

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