Review Article

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The effect of fluid therapy on maternal and neonatal acid-base status in elective cesarean section: A triple-blind, randomized, controlled trial

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Abstract

Background: Fluid therapy in perioperative cesarean section remains a debated topic. Its purpose is to maintain or restore circulating blood volume and may affect the plasma acid-base balance of mother and neonatal. Therefore, the aim of this study was to compare the effects of Normal saline with Ringer's lactate serum on the acid-base status of mother and neonate in elective cesarean section.

Methods: forty-eight healthy term parturient women scheduled for elective cesarean section were randomly divided into two groups (24 patients each). The first group received Normal saline serum and the second group received ringer lactate serum. Maternal blood samples were obtained from an indwelling cannula in a peripheral hand vein and Fetal arterial and venous blood samples were obtained at birth from a double-clamped umbilical cord. The data collected during the study included PH, PCO2, HCO3 and BE. At birth, 1- and 5-minute Apgar scores were recorded. Data were analyzed using descriptive statistics and inferential statistics at a significance level of less than 0.05.

Results: Patients did not differ significantly in terms of demographic characteristics. The acidosis in mothers was higher in lactated ringer group (5%, p <0.001). There was no difference in Apgar score between the two groups.

Conclusion: Normal saline compared to lactated ringer causes acidosis in mothers under elective cesarean section with spinal anesthesia, but none of them has a significant effect on the acid-base status of the infant. Appropriate fluid therapy aimed at optimization of pH can be effective for mothers who are at higher risk for acidosis.

Keywords: Lactated ringer; Normal saline; Cesarean section.

Background

Perioperative fluid therapy remains a debated topic [1]. Its purpose is to maintain or restore circulating blood volume [2]. To achieve central euvolemia, patients undergoing surgery within an enhanced recovery protocol should have an individualized fluid management plan [3]. Spinal anesthesia in pregnant women undergoing elective cesarean is usually associated with hypotension, which can have severe side effects on both mother and neonate [4, 5]. This fluid therapy may affect the plasma acid-base balance of mother and baby. Therefore, the aim of this study was to compare the effects of 0.9% sodium chloride serum with Ringer's lactate serum on the acid-base status of mother and neonate in elective cesarean section.

Methods

The current clinical trial is approved by the Ethics Committee and is registered at the Clinical Trials Registry of Iran (IR.TBZMED.REC.1397.034). Informed written consent was obtained from parents of all participants. The study was conducted from March 2018 to October 2019 at Alzahra Hospital, Tabriz. Patients were assigned by a random table of numbers into one of two groups. Group 1 patients received normal saline; group 2 patients received Ringer's lactate solution. Patients induced with 0.5% or 0.75% bupivacaine without epinephrine. All patients were placed on the operating room table in the supine position with left lateral uterine displacement and received oxygen at 4 Llmin by nasal cannula. Maternal blood pressure was measured. Maternal blood samples were obtained from an indwelling cannula in a peripheral hand artery and Fetal arterial and venous blood samples were

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obtained at birth from a double-clamped umbilical cord. The data collected during the study also included PH, PCO2, HCO3 and BE. At birth, 1- and 5-minute Apgar scores were recorded. Data were analyzed using descriptive statistics (independent t-test, paired t-test) and inferential statistics (Chi-square test, Mann-Whitney test, analysis of variance and repeated measures) at a significance level of less than 0.05.

Results

There were no significant differences between the groups in relation to demographics (P> 0.05, **Table 1**).

Table 1: *Characteristics of the women with ovarian endometrioma.*

	Normal saline	Ringer's lactate	p-value
Age	31.9±4.5	31.6±4.7	.826
BMI	25.1±2.5	25.1±3.4	.984

The situation related to the incidence of the acid-base status of mother was compared in the two groups, Results can be seen in **Tables 1.** All the studied factors are significant between the two groups, which indicates a higher acidity in the Normal saline group.

Table 2: *Acid-base status of mother before and after cesarean section.*

		before cesarean section	After cesarean section	p-value
PH	Normal saline	7.0±0.4	7.3±0.6	0.001
	Ringer's lactate	7.1±0.4	7.0±0.8	
PCO2	Normal saline	37.8±2.5	33.5±3.4	0.001
	Ringer's lactate	37.1±2.5	34.8±2.5	
HCO3	Normal saline	21.2±2.5	17.2±3.5	0.001
	Ringer's lactate	22.3±2.5	20.3±2.5	
BE	Normal saline	-1.1± -0.4	-4.8± -1.4	0.001
	Ringer's lactate	-0.6± -0.5	-3.1± -1.2	

The situation related to the incidence of the acid-base status of mother was compared in the two groups, Results can be seen in **Tables 2**.All the studied factors are significant between the two groups, which indicates a higher acidity in the Normal saline group.

Table 3: *Acid-base status of neonate after cesarean section.*

		After cesarean section	p-value
PH	Normal saline	7.0±0.7	0.88
	Ringer's lactate	7.0±0.8	
PCO2	Normal saline	49.5±7.4	0.83
	Ringer's lactate	49.8±3.5	
HCO3	Normal saline	21.2±3.5	0.95
	Ringer's lactate	21.3±2.5	
BE	Normal saline	-4.0± -1.4	0.83
	Ringer's lactate	-3.9± -1.2	
Apgar score at 1min	Normal saline	9.0±0.0	1.00
	Ringer's lactate	9.0±0.0	
Apgar score at 5 min	Normal saline	10.0±0.0	0.75
	Ringer's lactate	10.0±0.0	

Conclusion **Table 3** shows the neonatal acid-base, there was no significant difference in any of the variables and no acidosis was observed in acid-base status of neonate after cesarean section.

Discussion

The aim of this study was to compare the effect of Ringer's lactate serum with Normal saline on maternal and neonatal acid-base status in elective cesarean section. The results of the study show that the incidence of acidosis in mother's blood of the lactated Ringer group is lower than that of Normal saline group, which is a significant difference. In a study by Emmanuel Ayebale et al. (2017), which examined the effects of lactate ringer and Normal saline in emergency cesarean section, showed that the amount of maternal metabolic acidosis was significantly lower in the lactate ringer group [6]. In a study by Nesseler et al., 31% of patients in the Normal saline group developed metabolic acidosis, and patients in this group the patient developed hyperkalemia during surgery (k >6) and required treatment [7]. It seems that hartmann's solution (Ringer lactate) reduces metabolic acidosis compared to ringer serum and these changes can be due to ionic composition of solutions or compensatory process such as conversion of lactate to bicarbonate or bicarbonate to carbon dioxide, etc. Almost all the results of the above studies are in line with the results of the present study in that Ringer's lactate serum performs better in no change in PH rang.

Conclusion

Normal saline compared to lactated ringer causes acidosis in mothers under elective cesarean section with spinal anesthesia, but none of them has a significant effect on the acid-base status of the infant. Appropriate fluid therapy aimed at optimization of pH can be effective for mothers who are at higher risk for acidosis.

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