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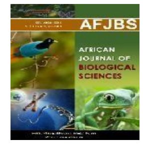

Randomized study of intraoperative administration of ringer lactate versus glucose saline in cancer pediatric patients undergoing major surgeries and its impact on electrolytes, glucose and pH

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Abstract

Background: Choosing an appropriate fluid therapy for patients during the surgery to have glucose and electrolyte balance and the lack of studies addressing children in this regard, the present study aimed at investigating the effect of different fluid therapy methods on blood sugar (BS), blood gases, and blood electrolytes in cancer children undergoing major surgery.

Materials and Methods: The current clinical trial was conducted on 58 children aged 1 year to 5years that were candidates for surgery. These patients were randomly divided into two groups undergoing intraoperative fluid therapy with Ringer Lactate and 5%dextrose in 0.9% saline. The values of hemodynamic parameters, BS, serum electrolytes (sodium, potassium, and chloride), and blood gases (pH, HCO3, and BE) were evaluated and compared among the three groups.

Results: The level of BS at the end of the surgery in Ringer's group was lower with mean 142.1±27.04mg/dl was significantly lower than its level in dextrose 5% in 0.9%saline: 189.20 ± 34.23; *P* value <<**0.001**)and after 24 hrs with mean167.45±36.73 in Ringer Lactate group in comparison to D5W with mean value 264.38±39.87;P value<0.001.The level of sodium In comparison to mean value ofNa level at end of surgery, there was asignificant increase in Ringer Lactate group than D5W (P value = 0.032) and after 24h, there was a significant decrease in Ringer Lactate than D5W (P value = 0.007).The pH level In comparison to mean value of pH at end of surgery, there was a significant decrease in Ringer Lactate than D5W (P value <0.001).On the contrary, HCO3, and lactate levels at the end of the surgery had no significant differences between the two groups . The amount of urine output at all follow-up times revealed a significant difference between Ringer's group and the other two groups (*P* value < 0.001).Heart rate and MAP measurements were insignificantly different between both groups.

Conclusion: Our finding concluded that ringer lactate solutions could significantly maintain the acid-base balance and glucose level and electrolytes balance in the perioperative period in children undergoing major surgeries compared to traditional 5% glucose in 0.9%saline.

Keywords: Pediatric Cancer patient,Lactated Ringer,dextrose 5%in 0.9%saline,complications of IV fluid,IV fluid administration.

INTRODUCTION:

Parenteral fluids are commonly administered in the hospital setting. For decades, clinicians have used a standardized approach for the prescription of maintenance IV fluids. Such an approach, however, has led to concerns regarding the development of hyponatremia using hypotonic fluids, especially in settings of heightened ADH release such as hypovolemia. Compared to balanced solutions for IV fluid administration, normal saline use has led to separate concerns regarding the development of hyperchloremic metabolic acidosis and acute kidney injury.(1)

Although the use of intravenous fluids is one of the most common interventions in medicine, the ideal fluid does not exist. In light of recent evidence, a reappraisal of how intravenous fluids should be used in the perioperative and critical care setting is warranted(2).

There is the possibility of hypoglycemia before or after anesthesia due to the inevitability of preparations before elective surgery, the existence of surgical stress, and the response of each person's body in a way that arouses the body's defenses(3). On the other hand, there is the possibility of hyperglycemia during the surgery due to the body's neuroendocrine response to surgical stress (4).

Children are also at a higher risk of excessive lipolysis and hypoglycemia due to their higher metabolism than adults. Studies in recent years show that the use of sugary liquids leads to hyponatremia or hyperglycemia, which can cause permanent neurological damage and even death in children(5).

Unfortunately, until now, an ideal fluid therapy method for maintaining BS at a suitable level in children has not been provided, and anesthesiologists determine the type of fluid therapy to be used according to the patients' specific conditions. Therefore, an issue that is always a point of disagreement between anesthesiologists is the use of sugary or non-sugary liquids during anesthesia. Some anesthesiologists prefer to administer sugary liquids, especially at the beginning of anesthesia due to the fear of hypoglycemia and its consequences.(6)On the other hand, some others reject the administration of sugary liquids during the surgery taking into account the phenomenon of stress and BS increase in response to the release of various hormones during the surgery. They believe that the occurrence of hyperglycemia during anesthesia can not only cause brain tissue edema and increase the excretion of essential body fluids and electrolytes but can also cause local tissue damage in tissues with reduced blood supply.(7,8)

MATERIAL AND METHODS

- **Study design**

This prospective, blind, randomized controlled trial was conducted on children aged 1-5 years undergoing major cancer surgery randomized into two groups, Group ringer lactate vs Glucose/Saline solution (5% dextrose in 0.9% saline).

- **Patient enrollment**

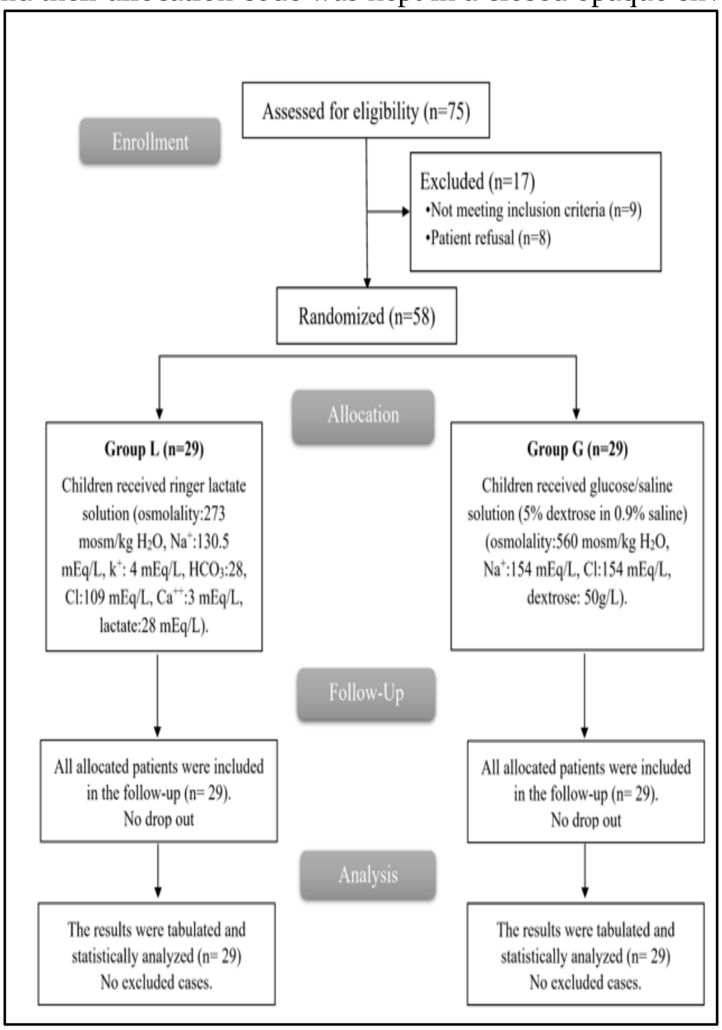
75 patients were assessed for eligibility, 9 patients did not meet the criteria and 8 patients guardian refused to participate in the study. The remaining patients were randomly allocated into two equal groups (29 patients in each). All allocated patients were followed-up and analyzed statistically.

Inclusion criteria include age from 1 to 5 years,both sexes,American Society ofAnesthesia (ASA) is II to III and children undergoing major surgeries (major surgeries it considered major if any

invasive operative procedure in which extensive resection was performed, e.g a body cavity is opened, organs are removed, or normal anatomy is altered).
Exclusion criteria include children with documented endocrine disturbances (diabetes mellitus, inborn errors of metabolism, hyperthyroidism), electrolyte imbalance (Na^+ level <135 or >145 mEq/L),renal disease,hepatic disease and children suffering from heart failure.

- **Randomization, intervention, and blinding**

After obtaining the code of ethics from the ethics committee of National Cancer Institute (approval code: IRB00004025), the clinical trial code (AP1907-30106), and written consent from the children's parents, 58 eligible children entered the study using random convenience sampling method. The children were divided into two equal groups of 29 in a parallel manner by computer generated numbers and their allocation code was kept in a closed opaque envelope.



Regarding Demographic data and ASA physical status of the studied groups In comparison to mean value of age, weight and height, there were insignificant differences between both groups. In comparison to percentage value of sex and ASA. Anesthesia was managed according to standardized protocol that was identical for each group.

The patients were subsequently induced with either intravenous induction or inhalational agent and 20G to 22G Cannula was inserted at the dorsum of the hand under complete aseptic conditions. 1.5cc of venous blood was drawn and analyzed on two occasions i.e; after induction of anaesthesiaand before extubation of the patients. The patients were intubated with endotracheal tube (ETT). The maintenance of anesthesia was achieved with Isoflurane with the Minimum Alveolar Concentration (MAC) of 1 to 1.2.

Ventilation of the patients was be delivered either with positive pressure ventilation (PPV) with Pressure Control mode to achieve tidal volume of approximately 5-8ml/kg with mixture of oxygen and air of 60% and 40% respectively. patient monitoring including invasive blood pressure. electrocardiogram, pulseoximetry,capnography,temperature probe and urine output

The study solutions were administered during the maintenance phase of anaesthesia and 24 hrs postoperative. The patients' temperatures were kept at least at 36 C with active warming methods. Patients followed a strict intraoperative fluid protocol. Anesthetists in charge within the operating room followed the *4-2-1 rule* (4 $ml·kg^{-1}·h^{-1}$ for the first 10 kg, 2 $ml·kg^{-1}·h^{-1}$ from 11 to 20 kg and 1 $ml·kg^{-1}·h^{-1}$ for every kg more than 20 kg) for the intraoperative fluid administration, replacing the number of hours of fasting plus the intraoperative requirements within the first 3 h of surgery . During the study phase of the anesthetic care, the study fluid was used for all aspects of intraoperative fluid therapy including the provision of maintenance fluids as well as replacement of deficits, third space losses(8ml/kg), and blood loss(surgical blood loss to be replaced by crystalloid 1:3 or colloid 1:1). In case of hypotension, a bolus of 10 $ml·kg^{-1}$of the same crystalloid infusion was given as a first step to re-establish the blood pressure within the normal range. packed red blood cells, or fresh frozen plasma were administered when required and recorded in the patient's case report form. Management of the anesthesia was left to the discretion of the anesthetist, as well as the intra- and postoperative analgesia handling. Soon after the induction of the anesthesia, having obtained a stable iv line, a sample with 2 ml of blood was sent to the central laboratory for the electrolytes (sodium, potassium,) determination, and 0.5 ml blood was also drawn for immediate blood gas analyses to determine pH, osmolarity, glycemia, and base excess. At the end of surgery, another 2.5 ml, divided as per the preoperative samples, was drawn and sent to the laboratory for electrolyte determination and gas analyses. Electrolytes determination and blood gas analyses were repeated hourly and used by the anesthetists as a guide for any intraoperative electrolyte, glucose, or hemoglobin replacement. Any fluid and blood product given during surgery, as well as any diuretic or drugs different from that of the study protocol, were accordingly recorded in the patient's case report form.

At the end of the surgery, anesthesia is discontinued, and a second blood sample was be obtained. The patients were subsequently reversed with standard reversal; IV atropine 0.02mg/kg and neostigmine 0.04mg/kg. Discharge to the ward after observation in Post anesthesia Care Unit (PACU).

Postoperative :

Children should start drinking fluids as early as possible after anesthesia. However, timing should be based on the child's urge to drink. Forced postoperative drinking is associated with increased vomiting. When early oral intake is not possible or insufficient, IV fluid support is essential to maintain normovolemia. Postoperative IV fluid management involves maintenance fluid according to "4-2-1"rule and fluid loss replacement (urine output and fluid loss in drains) . Thus, during the postoperative period, the fluid management priority is early oral fluid intake based on ameliorating thirst.

Data measurement

mean arterial blood pressure, heart rate and oxygen saturation were measured intra operatively every 5 min and on arrival in the postoperative anesthesia care unit (time 0) and at 30, 60, 90 min, 2, 4, 9, 12, and 24 hours postoperatively, serum glucose. ,change in pH, change in lactate level, bicarbonate level,sodium level and arterial sample for acid/base analysis.

Statistical analysis

Statistical analysis was done by SPSS v26 (IBM Inc., Chicago, IL, USA). The Shapiro-Wilks test and histograms were used to evaluate the normality of the distribution of data. Quantitative parametric variables were presented as mean and standard deviation (SD) and compared between the two groups utilizing unpaired Student's t- test. Quantitative non-parametric data were presented as median and interquartile range (IQR) and were analyzed by Mann Whitney-test. Qualitative variables were presented as frequency and percentage (%) and were analyzed utilizing the Chi-square test or Fisher's exact test when appropriate. A two tailed P value < 0.05 was considered statistically significant.

RESULTS

In this study, 75 patients were assessed for eligibility, 9 patients did not meet the criteria and 8 patients guardian refused to participate in the study. The remaining patients were randomly allocated into two equal groups (29 patients in each). All allocated patients were followed-up and analyzed statistically.

In comparison to mean value of age, weight and height, there were insignificant differences between both groups.

In comparison to percentage value of sex and ASA physical status, there were insignificant differences between both groups.

		Group L (n=29)	Group G (n=29)	P value
Age (years)	**Mean ± SD**	3.17 ± 1.42	3.07 ± 1.03	0.752
	Range	1 – 5	1 – 4	
Sex	**Male**	19 (65.52%)	17 (58.62%)	0.588
	Female	10 (34.48%)	12 (41.38%)	
Weight (kg)	**Mean ± SD**	16.97 ± 3.35	16.1 ± 2.34	0.261
	Range	11 – 23	12 – 21	
Height (m)	**Mean ± SD**	96.07 ± 9.7	96.53 ± 6.63	0.832
	Range	80 - 109.5	83.5 - 105	
ASA physical status	**I**	21 (72.41%)	17 (58.62%)	0.269
	II	8 (27.59%)	12 (41.38%)	

In comparison to mean value of serum glucose level at baseline, there were insignificant differences between both groups.

In comparison to mean value of serum glucose level at end of surgery and after 24h, there was a significant decrease in group L (normoglycemic) than group G (hyperglycemic) (P value <0.001).

In comparison to mean value of the change in serum glucose level between baseline and (end of surgery) and (after 24h), there was a significant decrease in group L (normoglycemic) than group G (hyperglycemic) (P value <0.001).

In comparison to mean value of the change in serum glucose level between baseline and (end of surgery) and (after 24h), there was a significant decrease in group L (normoglycemic) than group G (hyperglycemic) (P value <0.001).

		Group L (n=29)	Group G (n=29)	P value
Serum glucose level (mg/dl)	**Baseline**	123.55±32.88	137.41±44.28	0.181
	At end of surgery	142.1±27.04	196.59±37.33	**<0.001***
	Change between baseline and end of surgery	18.55 ± 22.85	59.17 ± 48.44	**<0.001***
	After 24h	167.45±36.73	264.38±39.87	**<0.001***
	Change between baseline and after 24h	43.9 ± 42.73	126.97 ± 43.53	**<0.001***

In comparison to mean value ofNa level at baseline, there was an insignificant difference between both groups.

In comparison to mean value ofNa level at end of surgery, there was asignificant increase in group L than group G (P value = 0.032).

In comparison to mean value of Na level after 24h, there was a significant decrease in group L than group G (P value = 0.007).

In comparison to mean value of the change in Na level between baseline and (end of surgery) and (after 24h), there were insignificant differences between both groups.

		Group L (n=29)	Group G (n=29)	P value
Na level (mEq/L)	**Baseline**	139.5±8.33	136.48±3.84	0.081
	At end of surgery	139.79±5.55	137.14±3.42	**0.032***
	Change between baseline and end of surgery	0.29 ± 5.62	0.66 ± 4.08	0.778
	After 24h	136±6.23	136.97±4.2	**0.007***
	Change between baseline and after 24h	1.46 ± 7.61	0.48 ± 5.45	0.576

In comparison to mean value of pH at baseline and after 24h, there were insignificant differences between both groups.

In comparison to mean value of pH at end of surgery, there was a significant decrease in group L than group G (P value <0.001).

In comparison to mean value of the change in pH between baseline and end of surgery, there was a significant decrease in group L than group G (P value <0.001).

In comparison to mean value of the change in pH between baseline and after 24h, there were insignificant differences between both groups.

		Group L (n=29)	Group G (n=29)	P value
pH	**Baseline**	7.36±0.05	7.38±0.03	0.130
	At end of surgery	7.3±0.07	7.38±0.07	**<0.001***
	Change between baseline and end of surgery	-0.06 ± 0.05	0 ± 0.06	**<0.001***
	After 24h	7.35±0.06	7.34±0.05	0.73
	Change between baseline and after 24h	-0.01 ± 0.08	-0.04 ± 0.06	0.161

In comparison to mean value of HCO_3 level at baseline, at end of surgery and after 24h, there were insignificant differences between both groups.

In comparison to mean value of the change in HCO_3 level between baseline and (end of surgery) and (after 24h), there were insignificant differences between both groups.

		Group L (n=29)	Group G (n=29)	P value
HCO_3 level (mmol/L)	**Baseline**	22.87±2.84	23.89±3.08	0.195
	At end of surgery	24.01±2.85	25.04±3.07	0.19
	Change between baseline and end of surgery	1.14 ± 0.05	1.15 ± 0.05	0.439
	After 24h	25.19±2.78	26.2±3.07	0.2
	Change between baseline and after 24h	2.32 ± 0.18	2.31 ± 0.08	0.712

In comparison to mean value of lactate level at baseline, at end of surgery and after 24h, there were insignificant differences between both groups.

In comparison to mean value of the change in lactate level between baseline and end of surgery, there was a significant increase in group L than group G (P value <0.001).

In comparison to mean value of the change in lactate level between baseline and after 24h, there were insignificant differences between both groups.

		Group L (n=29)	Group G (n=29)	P value
Lactate level (mmol/L)	**Baseline**	1.38±0.52	1.23±0.5	0.282
	At end of surgery	1.47±0.59	1.72±0.6	0.116
	Change between baseline and end of surgery	0.1 ± 0.34	2.95 ± 0.92	**<0.001***
	After 24h	2.53±0.99	2.5±1.03	0.907
	Change between baseline and after 24h	1.16 ± 0.97	1.27 ± 1.06	0.672

Heart rate and MAP measurements were insignificantly different between both groups

Heart rate (beat/min)	**Group L (n=29)**	**Group G (n=29)**	**P Value**
Preoperative	83.93±12.23	83.67±11.62	0.931
Post induction	86.7±12.23	85.5±11.65	0.699
30 min	81.73±11.35	82.8±11.99	0.725
60 min	79.67±11.52	80.63±12.3	0.755
90 min	79.67±11.52	79.5±12.34	0.798
120 min	79.87±11.61	80.53±12.54	0.832
4h	80.9±11.57	81.47±12.73	0.857
12h	82.8±11.72	83.8±12.63	0.752
24h	83.77±11.7	84.6±12.76	0.793

MAP (mmHg)	(L)group (n=29)	(G) group (n=29)	P value
Preoperative	**109.23±14.4**	**104.33±13.78**	**0.183**
Post induction	**90.8±19.51**	**84.2±17.07**	**0.168**
30 min	**90.8±19.51**	**82.3±17.24**	**0.168**
60 min	**90.27±19.4**	**83.43±17.18**	**0.154**
90 min	**91.93±19.48**	**85.47±17.15**	**0.178**
120 min	**91±19.4**	**84.43±17.06**	**0.169**
4h	**91.9±19.26**	**85.63±16.85**	**0.185**
12h	**93.87±19.34**	**87.9±16.45**	**0.203**
24h	**96.43±19.51**	**89.87±16.32**	**0.163**

DISCUSSION

Although there was no significant difference in measurement of serum glucose at baseline.It was noted that the mean value of serum glucose level was significantly high for group (G) at end of surgery and after 24h versus lower values (normoglycemic) in group L than group G (P value <0.001).

In 2021 **Gao and colleagues**[9] conducted single-center, double-blind randomized controlled study on 100 patients aged older than 1 month with an ASA score of I to II who received general anesthesia. Patients were randomly assigned to receive either 1% glucose isotonic lactated electrolyte or lactated Ringer's solution intraoperatively as a maintenance fluid. Patient demographics and the results of blood gas analysis at 1, 2, and 3 hours were documented, and changes in glucose and electrolyte concentrations and the acid–base status were analyzed. The results reported by their study have supported our results and have showed that the glucose level was insignificantly different in the ringer lactate group and 1% glucose isotonic Lactated electrolyte. The mentioned finding was consistent with that of the present study.

Different results were obtained by **(Nilsson et al., 1984)**[10] whose study was carried on two equal groups of children (n = 35): group A received a Ringer acetate solution (Ringerdex, Pharmacia AB Sweden) during operation, and group B received Ringer glucose with 2.5% glucose (Ringer-glucose, ACO AB Sweden). In both groups the rates of infusion were 15-20mlkg" during the 1st hour followed by 5-10 ml/ kg/ h.

The preoperative blood-glucose concentrations for all patients (n = 70) are compared with age and duration of starvation, respectively. The lowest blood glucose concentration before operation was 2.9 mmol litre^{-1}. No significant correlation (linear regression)were obtained between preoperative blood-glucose concentrations and age, weight or the duration of starvation. The medians and ranges for age and weight, and the means (± SD) for the duration of starvation period, duration of operation and perioperative fluid administration did not differ significantly between the two groups .

Blood-glucose concentrations had increased significantly in both groups after surgery (P<0.001; *t* test). The increase in blood-glucose concentration in group B was significantly greater than that in group A (P < 0.001; *t* test). None of the patients washypoglycaemic after surgery. On the contrary, several children in group B (Ringer glucose)had high values.

It was shown that ringer solution group had higher glucose levels compared to the other solutions the different results may be due to adding 2.5% glucose to the ringer solution in **Nilsson et al.**'s study.

K J Chinet al., 2006(11) conducted a randomized controlled trial in 50 non-diabetic adult patients undergoing elective surgery which did not involve entry into major body cavities, large fluid shifts, or require administration of >500 ml of intravenous fluid in the first two hours of peri-operative care. Patients received 500 ml of either 5% dextrose in 0.9% normal saline, lactated Ringer's solution, or 0.9% normal saline over 45 to 60 minutes. Plasma glucose, electrolytes and osmolarity were measured prior to infusion, and at 15 minutes and one hour after completion of infusion. None of the patients had preoperative hypoglycaemia despite average fasting times of almost 13 hours. Patients receiving lactated Ringer's and normal saline remained normoglycaemic throughout the study period. Patients receiving dextrose saline had significantly elevated plasma glucose 15 minutes after completion of infusion (11.1 (9.9-12.2, 95% CI) mmol/l). Plasma glucose exceeded 10 mmol/l in 72% of patients receiving dextrose saline. There was no significant difference in plasma glucose between the groups at one hour after infusion, but 33% of patients receiving DS had plasma glucose > or = 8 mmol/l. That agrees with our results.

Souvik Maitra et al.,2013(12) study was undertaken to observe the effect of different maintenance fluid regimen on intraoperative blood glucose levels in non-diabetic patients undergoing elective major abdominal surgery under general anesthesia.

Two hundred non-diabetic patients (100 in each group) of ASA physical status I and II of either sex, aged between 18 years and 60 years were enrolled for this prospective randomized parallel group study. Group A patients received Ringer's lactate (RL) solution as maintenance fluid and Group B patients received 0.45% sodium chloride with 5% dextrose and 20 mmol/L potassium chloride, as per calculated hourly infusion rate according to their body weight. Fluid deficit arising from overnight fasting was corrected by the maintenance fluid. Fifty percent of total deficit was corrected in the first hour and the remaining 50% was corrected in next 2 h.

Supporting our results, they found that CBG level increases with progression of surgery irrespective of maintenance fluid regimen and the mean CBG values at 1st, 2nd and 3rd h are significantly higher in patients those who are receiving 0.45% sodium chloride with 5% dextrose and 20 mmol/L potassium chloride as maintenance fluid in contrast to those receiving RL solution. Exogenous insulin requirement to maintain normoglycemia is significantly higher in patients receiving dextrose containing solution is also significantly higher than those receiving RL solution. Percentage of hyperglycemic episodes in group B patients is also significantly higher than group A patients.

In line to our results**, AnanchanokSaringcarinkuland <u>KriengsakKotrawera</u>** in 2009[13] have conducted A prospective randomized double-blind control trial was conducted on 60 patients aged 18-60, with ASA physical status I to II, who were scheduled for elective surgery at Maharaj Nakorn Chiang Mai Hospital, Thailand between October; 2007 and September; 2008. The patients received either lactated Ringer's solution (Group L), or 5% dextrose in 0.45% NaCl (Group D) in the morning of the operation day. Blood glucose levels were determined before intravenous fluid administration, at the beginning, after the 1st hr, and at the end of surgery. Mean duration of preoperative fast was almost 11 hrs in both groups; however, none of the patients had preoperative hypoglycemia. The blood sugar levels were significantly higher in the patients receiving 5% dextrose solution compared to the patients receiving lactated Ringer's solution at the beginning, after the 1st hr and at the end of surgery (p-value = 0.06, 0.018 and 0.036 respectively). There were some patients having hyperglycemia after receiving 5% dextrose in 0.45% NaCl during surgery. However, none of the average plasma glucose values in either group was considered as hyperglycemia.

Regarding Lactate level in our studied groups there was no significant difference at baseline,at end of surgery, after 24h between both groups.

But the change in lactate level between baseline and end of surgery was significantly higher in group L than group G (P value <0.001).

Although the change in lactate level between baseline and after 24h was insignificantly different between both groups.

In 2020 **King and his colleagues**[14]have made a cohort study including 59 patients, who were randomized 20 to NR, 20 to NS, and 19 to LR. For the study cohort, the mean age was 14 ± 2 years and the mean weight was 58 ± 17 kg. There were no differences in age, weight, body mass index, gender or American Society of Anesthesiologists (ASA) physical status between the 3 groups, except that there was an over-representation of males in the LR group (53% in LR versus 85% in NS). Base deficit was measured at the beginning of the case and either at the end of the surgical procedure or when there was a clinical need for another type of fluid (colloid). Of the 59 patients, Base deficit became more negative in 38 patients during the procedure. Patients who received NS had a statistically significant increase in base deficit when compared to those who received LR or NR. Furthermore, 27 patients had an increase in base deficit ≥ 2, 12 of whom received NS compared to 6 who received NR and 9 who received LR. The difference in proportions between NS and NR did not reach the prespecified statistical significance threshold of p=0.025 (difference = 30%; 95% confidence interval [CI] of difference: 0%, 59%; p=0.057). Likewise, the difference in proportions between NS and LR did not reach statistical significance (difference = 17%; 95% CI of difference: −13%, 47%; p=0.275).

Contrasted to our results **(King et al., 2020)**[14] revealed that at the first ABG measurements the lactate level was significantly higher in ringer lactate group compared to the normal saline group while they agreed to our results in the final ABG measurements as there was comparable findings in the second ABG measurements and comparable lactate change between groups.

According to our study Na level of the studied groups the Na level at baseline was insignificantly different between both groups.

But Na level at end of surgery was significantly higher in group L than group G (P value = 0.032).

And also ,Na level after 24h was significantly lower in group L than group G (P value = 0.007).

Also, **(Sajedi et al., 2023)**[3] have conducted their clinical trial on 105 children aged 6 months to 4 years that were candidates for surgery randomly divided into three groups undergoing intraoperative fluid therapy with 1/5-4/5 serum, Ringer's, and 1/3-2/3 serum. The level of blood sugar at the end of the surgery in Ringer's group with mean 166.20 ± 39.46 mg/dl was significantly lower than its level in the other two groups (1/5-4/5 serum: 241.00 ± 51.11 and 1/3-2/3 serum: 189.20 ± 34.23; P value < 0.05). Moreover, pH, HCO3, and BE at the end of the surgery had significant differences between the three groups (P value < 0.05). The amount of urine output at all follow-up times revealed a significant difference between Ringer's group and the other two groups (P value < 0.001).

In line with our results, **(Sajedi et al., 2023)**[3] reported that Na level at baseline showed insignificant difference between ringer lactate group and serum group. While they differed from our results as they found insignificant differences between groups regarding Na level after surgery and after 2h following the surgery.

(Gao et al., 2021)[9] showed that Na level at baseline was insignificantly different between ringer lactate and the treatment groups. They differed from our results when comparing Na level between groups at different intervals as there was insufficient difference between groups which is with our results.

Different results were obtained by **(King et al., 2020)**[14] who showed that that there was no statistically significant difference in Na between ringer lactate group and normal saline group in the first and second measurements with comparable pH change between groups. The small sample size in our study and different range of age and different surgery type may account for the conflicting results.

On contrary to our results, a study was done **by Mirezweska in 2015**[15] 91 children, ASA I and II, undergoing elective ENT surgery were enrolled to this prospective, randomized, open-label study. They were randomly assigned to receive: group G5W: 5% glucose in water solution, group GNaCl: 3.33% glucose in 0.3% NaCl, and group RA: Ringer's acetate. Serum glucose, sodium, potassium, phosphate concentrations and serum osmolality were analysed before induction of anaesthesia, immediately after completion of surgery and 60 min later. Postoperative hyponatraemia occurred in 36% of patients in the group G5W, and in 3.7% in the group GNaCl. Neither hyperglycaemia nor hyponatremia occurred in the group RA.

Opposite to our results, **In 2022 Shatabiet al.,**[16] have conducted a study enrolling 70 infants were selected and assigned by block randomization in two groups of 35. Patients in Group A received fluid therapy with normal saline 0.9% (10 cc/kg/h) and DW 5% NaCl 0.45% solution in Group B (10 cc/kg/h). Group B, Na level decreased.

Regarding pH level of the studied groups the pH at baseline and at end of surgery was significantly lower in group L than group G (P value <0.001).

pH after 24h was insignificantly different between both groups.

The change in pH between baseline and end of surgery was significantly lower in group L than group G (P value <0.001).

The change in pH between baseline and after 24h was insignificantly different between both groups.

(Sajedi et al., 2023)[3] agreed to our results, as they found that pH was significantly lower in the ringer lactate group compared to serum solution infusion groups.

Different results were obtained by **(Gao et al., 2021)**[9] who showed that there was no significant difference between groups in the ringer lactate group and the novel solution treatment group. The different results may be due to the different sample size and age range as well as the different solutions.

In contrary to our results, **(King et al., 2020)**(14) showed that there was no statistically significant difference in pH between ringer lactate group and normal saline group in the first and second measurements on the other hand, they came with our results regarding the comparable pH change between groups.

Shatabi et al.,2022(16)in line with our results There was no significant difference in the mean value of blood acidity (pH) in the study groups.

Regarding HCO3 level of the studied groups in comparison to mean value of HCO3 level at baseline, at end of surgery and after 24h, there were insignificant differences between both groups.

In comparison to mean value of the change in HCO3 level between baseline and (end of surgery) and (after 24h), there were insignificant differences between both groups.

Against our results, **(Sajedi et al., 2023)**(3) found that HCO3 level was significantly higher in the ringer lactate group compared to serum solution infusion groups.

In accordance with our findings, **(Gao et al., 2021)**(9) revealed that there was no significant difference between ringer lactate group and the tested infusion solution at different time intervals. As The two groups displayed the same variations of bicarbonate concentrations, and the changes were all within the physiological range.

Shatabi et al.,2022(16)in line to our results There was no significant difference in the mean value of bicarbonate level (HCO3) in the study groups

Conclusion:

Our finding concluded that ringer lactate solutions could significantly maintain the acid-base balance and glucose level and electrolytes balance in the perioperative period in children undergoing major surgeries compared to traditional 5% glucose in 0.9% saline.

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