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EFFECTS OF STEROFUNDIN AND RINGER'S LACTATE ON ACID- BASE STATUS IN POST-SURGICAL AND TRAUMA PATIENTS.

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ABSTRACT

Background: To study the effect of Ringer Acetate (Sterofundin B Braun®) and Ringer's Lactate on acid- base status and serum electrolyte in post-surgical and trauma patient.

Methods: Post-surgical and trauma patient who had hypotension at the time of admission in ICU were enrolled in this study. 40 patients were randomly allocated into 2 groups. Group SF and Group RL received Sterofundin and Ringer's lactate respectively. To achieve systolic blood pressure > 90 mmHg and urine output > 0.5 ml/ kg/ h, repeated bolus (200 ml) followed by maintenance fluid at 1.5 ml/kg/hr. was given. Outcome measures were acid- base status, serum electrolyte.

Results: No statistically significant difference was observed in pH, bicarbonate, sodium, potassium PO2 and PCO2 at admission and different time periods between two groups. Baseline serum lactate level, Group SF vs. Group RL (2.80±0.41 vs. 3.08±0.72 p=0.14) was similar. Group SF had significantly lower serum lactate levels at 6h, 12h, 18h and 24h (1.97 vs. 2.76, p=0.002; 1.70 vs. 2.28, p=0.01; 1.25 vs. 2.01, p=0.001; 1.09 vs. 1.93, p=0.0001).

Conclusion: Sterofundin may be preferred volume replacement solution in post-surgical and trauma cases, as it was associated with low serum lactate levels.

KEYWORDS : Ringer's Lactate, Electrolyte, Hypotension, Trauma, serum lactate.

INTRODUCTION:

Fluid therapy plays an important role in the management of patients recovering from major surgery and trauma. Postoperative fluid management comprises maintenance fluid, replacement of on-going losses and correction of anaemia or hypovolemia [1]. Early correction of hypovolemia should be done as prolong hypoperfusion can cause organ dysfunction [2].

RL and SF have almost similar composition to plasma. SF is a balanced isotonic solution for intravenous infusion and contains (Na - 140, k - 4.0, Ca - 2.5, Mg - 1, and Cl - 127 mmol/l) and acetate (24 mmol/l) and maleate (5 mmol/l) which is widely metabolized in all organs and muscles[3].

RL contains sodium (130 mmol/L), potassium (5 mmol/L), calcium (1 mmol/l) and magnesium (1 mmol/l), chloride (112 mmol/L) lactate (27 mmol/L). The lactate in RL was added to reduce the chloride content, thereby reducing the incidence of hyperchloremic metabolic acidosis which usually occurs after infusion of large volumes of normal saline during the intraoperative period [3].

Acetate containing solutions have been introduced as an alternative to lactated solutions as the metabolism of acetate is less dependent upon hepatic function. Solutions with acetate have shown improved survival and better metabolic profile in patients undergoing abdominal surgery [4]. Acetate is metabolized in muscle rather than liver, which makes Ringer's acetate a reasonable alternative to Ringer's lactate in patients with liver failure.

Short-term infusion of lactated Ringer's solution in normal adults who are haemodynamically stable does not falsely increase circulating lactate concentrations when 1 L of fluid was infused over a period of 1 h [5]. However Sterofundin may be more beneficial fluid than Ringer's lactate in patients with liver dysfunction [6].

The aim of this study is to compare the effect of two different fluid administrations (Sterofundin and Ringer Lactate) on acid- base status and plasma electrolyte in postoperative and trauma patients. The secondary objectives were to access effect on haemodynamics of patient.

MATERIAL AND METHODS:

The study was carried-out in the intensive care unit (ICU) of a tertiary care centre situated in Uttar Pradesh, India. After obtaining permission from institutional Ethical committee, study was performed in a prospective randomized controlled pattern.

Adult patients with ASA physical status of I–III, shifted to ICU after major surgery or trauma were screened for study. All patient of our study were either postoperative cases of gastric carcinoma, oesophageal carcinoma, colon carcinoma, ano-rectal carcinoma or trauma patient requiring critical care. Most of the patient were intubated and on ventilatory support. Patient with sepsis, cardiac disease, and diabetes, significant hepatic dysfunction (liver enzymes >50% upper limit of normal value) or renal dysfunction (creatinine > 50% upper limit of normal value) were excluded from study.

All patients were monitored for blood pressure, central venous pressure, heart rate, SpO2, temperature and urine output. Of these patients who have hypotension (systolic blood pressure < 90 mmHg) at time of admission in ICU were enrolled in this study. A total of 40 patients included in this study were randomized into two groups SF and RL (20 each).

Once the systolic blood pressure less than 90 mmHg (inclusion criteria) was recorded, then patient was treated initially with incremental boluses of intravenous fluid. Patients allocated to SF group were treated with intravenous fluid Sterofundin. Patients allocated to Group RL were given Ringer's lactate. Patients were assessed after fluid challenge to determine whether the target hemodynamic/urine output goals were achieved. Goal of giving intravenous fluids were to achieve SBP more than 90 mmHg and urine output more than 0.5 ml/kg/hr. If hemodynamic or urine output were not improved with the first bolus of fluid, additional boluses of RL solution were administered. Patients who did not respond to fluid boluses or if central venous pressure was reached up to 10-12 cmH2O then noradrenaline infusion was started in titrated doses.

Duration of our entire study was first 24 hours after admission in ICU. After achieving systolic blood pressure of 90 mmHg, intravenous fluid was given at 1.5 ml/kg/h. Packed red blood cell transfusion was given if haemoglobin fell below 8.0 gm /dl.

We collected and recorded base line blood gases, serum electrolytes, serum lactate level at the time of ICU admission. Blood gases analysis including serum lactate level was done 6 hourly and serum electrolyte measurement was done at every 12 hours.

The collected data was analysed and results were presented in mean±SD and percentages. The Chi-square test was used to compare the categorical variables. The Unpaired t-test was used to compare the continuous variables between the groups. The repeated measures of analysis of variance of general linear model was used to test the effect of time and time to group interaction across the time periods. The p-value<0.05 was considered significant. All the analysis was carried out on SPSS 16.0 version.

RESULTS:

The mean age of patients in Group SF and Group RL was 37.80 (±11.65) and 35.05 (±8.76) years. More than half of patients in both the groups were females. Both groups were comparable age and sex. Majority of patients were post-operative case, in group SF (65%) and Group RL (70%) and rest were traumatic cases. Total amount of fluids (ml) in Group SF and Group RL was 4180 (±139.9) and 4120 (±110.5) ml. No significant difference total amount of fluids given during first 24 hrs stay in ICU [Table-1].

Table 1: Demographic profile and amount of fluids

Variables	Group SF (n=20)	Group RL (n=20)	p-value
Age (years) (Mean±SD)	37.80±11.65	35.05±8.76	0.73
Sex (Male/Female)	9/11	6/14	0.32
Postoperative cases N (%)	13 (65)	14 (70)	0.12
Traumatic cases N (%)	7 (35)	6 (30)	
Total Amount of fluid given(ml) (Mean±SD)	4180.00±139.92	4120.00±11 0.52	0.12

Group SF: Sterofundin, Group RL: Ringer's Lactate, [1]Unpaired t-test

There was no significant (p=0.61) difference in pH at baseline between Group A (7.32±0.09) and Group B (7.31±0.09). No significant (p>0.05) difference was observed in pH at different time periods [Table-2].

Table-2: Comparison of pH between the groups across the time periods

Time	Group SF (Mean±SD)	Group RL (Mean±SD)	p-value[1]
Baseline	7.32±0.09	7.31±0.09	0.61
6 hours	7.34±0.07	7.34±0.08	0.92
12 hours	7.37±0.06	7.34±0.08	0.27
18 hours	7.38±0.06	7.34±0.08	0.16
24 hours	7.40±0.04	7.36±0.08	0.12

Group SF: Sterofundin, Group RL: Ringer's Lactate, [1]Unpaired t-test

A slight decrease in bicarbonate was found from baseline to 18 hours in Group A and increase in Group B at 24 hours. No significant (p>0.05) difference was observed in bicarbonate at different time periods between the groups.

Baseline serum lactate level in both groups was similar and here was no significant difference. Serum lactate was significantly (p<0.01 to <0.0001) lower in Group A compared to Group B at 6, 12, 18 and 24 hours [Table-3].

Table-3: Comparison of serum bicarbonate and lactate across the time periods

Time	Group SF (Mean±SD)	Group RL (Mean±SD)	p-value[1]
Serum Bicarbonate Level(mmol/L)			
Baseline	24.44±10.07	19.35±7.17	0.07
6 hours	23.13±6.26	19.99±6.53	0.12
12 hours	23.26±4.51	20.19±4.98	0.06
18 hours	21.83±4.59	20.05±4.13	0.20
24 hours	21.92±3.67	20.46±3.33	0.19
Serum Lactate Level(mmol/L)			
Baseline	2.80±0.41	3.08±0.72	0.14
6 hours	1.97±0.65	2.76±0.82	0.002*
12 hours	1.70±0.66	2.28±0.73	0.01*
18 hours	1.25±0.44	2.01±0.87	0.001*
24 hours	1.09±0.38	1.93±0.70	0.0001*

Group SF: Sterofundin, Group RL: Ringer's Lactate, [1]Unpaired t-test

Level of serum sodium and potassium was similar in both groups and there was not any significant difference between groups at baseline and at all time periods [Table-4].

Table-4: Comparison of Serum sodium and potasium between the groups.

Time	Group SF (n=20)(Mean±SD)	Group RL (n=20)(Mean±SD)	p-value[1]
Serum Sodium Level(mmol/L)			
Baseline	133.26±5.61	133.88±5.24	0.71
12 hours	136.12±5.48	137.01±3.94	0.56
24 hours	138.56±4.31	138.68±2.78	0.91
Serum Potasium Level(mmol/L)			
Baseline	4.27±0.50	4.01±0.78	0.71
12 hours	4.01±0.52	3.96±0.65	0.56
24 hours	3.92±0.35	3.91±0.59	0.91

Group SF: Sterofundin, Group RL: Ringer's Lactate, [1]Unpaired t-test

There was no statistically significant (p>0.05) difference in PO2 value at baseline in both Groups. PO2 increased in both the groups from baseline to subsequent time period. On comparing the PO2 between the groups across the time periods no significant difference was found. It was observed that there was no significant difference in PCO2 at baseline and at different time periods between Groups [Table-5].

Table-5: Comparison of PO_2 and PCO_2 between the groups across the time periods

Time	Group SF (n=20) (Mean±SD)	Group RL (n=20) (Mean±SD)	p-value[1]
Po_2 Values			
Baseline	108.74±24.36	118.52±42.66	0.19
6 hours	117.73±21.10	125.72±58.20	0.37
12 hours	121.40±28.46	129.71±72.70	0.99
18 hours	122.40±67.39	130.70±63.91	0.16
24 hours	125.74±53.13	135.24±74.55	0.06
PCO_2 Values			
Baseline	33.58±7.04	30.51±4.47	0.10
6 hours	34.12±6.60	30.35±6.29	0.07
12 hours	33.68±5.66	31.83±5.70	0.31
18 hours	33.60±4.94	32.97±4.33	0.66
24 hours	32.96±4.44	33.03±3.98	0.95

Group SF: Sterofundin, Group RL: Ringer's Lactate, [1]Unpaired t-test

On analysing the values of MAP at baseline and subsequent time periods between Groups, no significant difference was found between groups. MAP increased in both the groups from baseline to subsequent time periods. Heart rate decreased in subsequent time in both groups [Table-6].

Table-6: Comparison of MAP and HR between the groups across the time periods

Time	Group SF (n=20) (Mean±SD)	Group RL (n=20) (Mean±SD)	p-value[1]
Mean Arterial Pressure (MAP)			
Baseline	58.35±2.18	57.25±1.99	0.10
1 hour	59.10±2.02	58.00±2.02	0.06
2 hours	61.75±2.55	60.70±1.80	0.14
6 hours	67.15±3.78	67.15±3.77	1.00
12 hours	70.85±4.04	69.85±4.91	0.48
24 hours	73.70±3.55	73.15±5.17	0.69
Heart Rate (HR)			
Baseline	121.60±7.78	123.70±8.07	0.40
1 hour	114.50±6.60	116.85±8.48	0.33

2 hours	107.85±12.08	107.75±11.22	0.97
6 hours	94.85±7.23	95.80±8.82	0.71
12 hours	87.10±6.53	89.30±8.31	0.35
24 hours	82.60±4.57	84.75±7.67	0.28

Group SF: Sterofundin, Group RL: Ringer's Lactate, [1]Unpaired t-test
The SO_2 values were similar in both the groups from baseline to subsequent time periods and no significant difference was found.

DISCUSSION:

The purpose of present study was to compare two crystalloids as intravenous fluid regime in ICU. Major surgery and trauma are associated with substantial fluid shift and blood loss with the potential for hemodynamic instability in postoperative period. The primary objective was to evaluate the effect of two different fluids on acid–base status and electrolyte status. In current study there were no significant differences concerning distribution of age, sex and total amount of fluid administered in both group.

Balanced solutions such as Ringer's Lactate and Sterofundin contain bicarbonate precursors (lactate or acetate), so there may be a possibility for these solutions to produce metabolic alkalosis after larger volumes are administered [7]. Few studies indicate that metabolic alkalosis has been associated with worse outcomes in the critically ill patient [8]. However in current study we did not found metabolic alkalosis in both groups.

In our study no significant difference in serum lactate at baseline was found between groups. The major finding of the current study is that serum lactate was significantly lower in Group SF compared to Group RL at 6, 12, 18 and 24 hour. Difference in serum lactate level in our study was similar to study carried by Klaus F Hofmann-Kiefer et al.(2012) [9]. They conducted study on patients who were planned to undergo major, open gynaecology cancer surgery. Intra-operatively either ringer acetate or ringer lactate was given. They found that serum lactate concentrations were significantly elevated in RL.

Our result was different from study conducted by Didwania A. et al.(1997) on healthy, adult volunteer subjects. Patients were randomized to receive infusion of either ringer's lactate, normal saline or 5% dextrose. They concluded that short-term infusion of lactated Ringer's solution in normal adults does not falsely increase circulating lactate concentrations when it is given 1 litre over 1 hr [10]. This difference was probably because in contrast to healthy volunteer patients, our patients were undergone major surgery and were hypotensive at the time of admission in ICU.

In the present study, there was no significant difference in MAP at baseline between Group A and Group B. MAP increased in both groups from baseline to subsequent time period. There was no significant difference in MAP at all the time of period between the groups. This was probably because haemodynamic parameters depend on adequacy of intravenous fluid given, and in current study similar amount of fluid was given in both groups [4180 (±139.9)ml vs 4120 (±110.5) ml].

In this study, there was no significant difference in serum sodium and potassium at baseline or other time period. They were almost similar from baseline to 12 and 24 hours. Similar observation was made by Hasman et al, (2012). In their study ninety patients participated who were admitted with dehydration in the emergency department. They found no significant changes in potassium, sodium, or chloride levels [11].

In our present study, there was no significant difference in bicarbonate at baseline between Group SF and Group RL. A decrease in bicarbonate was found from baseline to further time period in Group SF. Similar results were found by Rajan S.et al.(2017) on patient undergoing major head and neck surgeries. Sterofundin or ringer's lactate was given intravenously at the rate of 10 ml/kg/hr to maintain systolic blood pressure above 90 mmHg. They did not notice any significant difference in serum sodium, potassium, chloride, bicarbonate and pCO_2 [12].

LIMITATION:

Observation period of current study was 24 hours which was small in comparison of total duration of stay in ICU. Sample size was also small which could have undermined the strength of study.

CONCLUSION:

The results of our study suggested that the sterofundin is the better volume replacement solution in the initial treatment of postoperative and truama patient. Use of sterofundin in these patients was associated with low levels of serum lactate in comparison with Ringer's Lactate.

CONFLICT OF INTEREST- None

FUNDING- None

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