Fluid Resuscitation: Ringer Lactate Versus Normal Saline-A clinical Study

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ABSTRACT

Introductuion: Field of trauma care has evolved tremendously, generally blood products are recommended for fluid resuscitation however in situations where the blood products are not available there may be a need for replacement with suitable replacements fluids like Ringer Lactate and Normal saline. This study compares the efficacy of both the replacement fluids on hemodynamics and metabolic responses of the patients.

Material and Methods: This study was conducted in Hospital 26 patients with mild haemorrhage after trauma was selected for the study. They were divided randomly into two groups Group I receiving Normal Saline and Group II receiving RL. Hemodynamics were measured and blood samples were collected at 0 minutes, 15 min, 1 hour, 3 hours and 6 hours after resuscitation and the data was recorded and analyzed.

Results: The Normal Saline group resuscitation with 139 ± 10ml/Kg produced MAP values to the level of 83.75mmHg. In LR group resuscitation with 100 ± 10ml/Kg produced the Mean arterial pressure values of 85.42mmHg. Base excess was lowered by hemorrhage and resuscitation with Ringer lactate improved the Base Excess but not with Normal saline. Serum Potassium levels were found to be increased with Normal saline but not with Ringer Lactate.

Conclusion: Ringer Lactate is found to be superior to Normal saline for fluid resuscitation because Normal saline has vasodilator effects with the increase in serum potassium levels and risk of metabolic acidosis. Although there were no significant differences found in the clinical outcomes, duration of admission and hospitalization between patients resuscitated with Normal Saline and Lactate Ringer solution.

Keywords: Fluid Resuscitation, Normal Saline, Ringer Lactate.

INTRODUCTION

Normal Saline (NS) 0.9% Sodium Chloride solution and Ringer's Lactate also called as lactated Ringers (LR) are the two primary fluids used in resuscitation. They have been used as crystalloid solutions for decades.[1,2] Crystalloid solutions contain crystals of sugars or salts dissolved in water. They are based on the ability of the fluid to cross cellular membrane thus altering fluid levels or providing fluid expansion. Crystalloid solutions are used to replace fluids most important of which includes blood loss in trauma. Damage control resuscitation was introduced recently which suggests initiating the early use of blood products for severely injured hypotensive trauma patients.[3-5] when blood products are not readily available the crystalloid solutions remains the important tool for survival of the patient. Normal saline contains approximately 154mM Na^+ and Cl^- with average pH of 5.0 and osmolarity of 308mOsm/L. LR solution has electrolytes 130mM Na+, and 109mM Cl-, 28mM lactate. The Average pH of LR is 6.5 and is slightly hypo-osmolar with 272mOsm/L.[6,7] Normal saline is therapeutically used for blood storage and blood transfusion.[8,9] Animal and human studies[10-14] of have shown that infusions of moderate to large volumes of NS can cause hyperchloraemic acidosis and cause greater interstitial oedema than other balanced colloids.[10] Hyperchloremia can cause renal vasoconstriction, decreased renal artery flow velocity and reduce GFR[15] can lead to salt and water retention.

LR acid base balance is considered superior to that of Normal saline[16,17] LR better acid base balance has shown to improve survival in experiments rat models with massive hemorrhage[18] similar results were also observed in pigs[19] suggesting the superiority of LR in cases of severe trauma. However lactate of LR is metabolized in the Liver forming bicarbonate the key buffer in preventing acidosis. LR should not be administered to patients with liver problems. LR also contains calcium capable of binding to anti-coagulants during blood transfusion can also cause blood clots. LR is also contraindicated for use with Nitroglycerin, Nitroprusside, Nor-Epinephrine, Propranolol and Methylprednisone infusions. It is unclear whether the hypercoagulability is of much concern, several multicenter survey of pre-hospital interventions have favored the use of NS by 73% to 17% for LR[20] with this dilemma we in the present study tried to evaluate the effect of fluid resuscitation in mild to moderate hemorrhage patients after trauma.

MATERIALS AND METHODS

The study was conducted in tertiary trauma care hospital permission for the study was obtained from the institutional ethical committee. Written consent was obtained from all the patients of the study. Patients with no serious trauma and mild to moderate blood loss were included in the study. All the participants were between 20 to 30 years of age. Excluded in the study were the patients with serious trauma, head injuries, severe blood loss and extensive trauma.

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Patients with the history of hypertension, Diabetes and other comorbid conditions were not included in the study. Total numbers of patients were n=26 and the patients were randomly divided into the two groups, Normal Saline group (NS) [n=13] group and Lactate Ringer (LR) group [n=13]. The blood samples were collected at 0 minutes, 15 min, 1 hour, 3 hours and 6 hours after resuscitation and the data was recorded and analyzed. While patients will be receiving i.v. fluids they will be kept on continuous cardiac and oxygen monitoring system. Although it is unlikely that subjects will need any medical emergency during this study however there was an attending physician/resident present at all times for the duration of study. If any subject develops adverse effects they will be promptly treated accordingly.

STATISTICAL ANALYSIS

Descriptive statistics like mean and percentages were used for the analysis. Microsoft office 2007 was used for analysis.

RESULTS

Most of the patients had lowered values of Mean Arterial Pressures the average mean arterial pressure before starting of resuscitation in the patients was 66.25mmHg. In the Normal Saline group resuscitation with 139 ± 10ml/Kg produced MAP values to the level of 83.75mmHg. In LR group resuscitation with 100 ± 10ml/Kg produced the Mean arterial pressure values of 85.42mmHg - figure 1.

The heart rates were recorded before the resuscitation and after resuscitation. The average heart rates were found to be increased as a result of hemorrhage, trauma and sympathetic activation. The average initial values were 121.33 BPM when resuscitation was done with Normal saline the heart rates after 2 hours were 93 BPM average and resuscitation with LR reduced the heart rates to 88.67 BPM after 2 hours - figure 2.

The average urine output before starting resuscitation was 80.5ml/hr before the starting of resuscitation. Normal saline increased the urine output to an average of 685.34ml/hr and Ringer lactate increased the average urine output to about 553.34ml/hr. The total average increase in urine output in Normal Saline group was almost double that of Ringer Lactate group – figure 3,4.

Base excess came to lower values on Hemorrhage and it increased to higher levels in case of Resuscitation with LR as compared to resuscitation with Normal Saline. Plasma lactate levels rose to 8.5mM average after hemorrhage and started decreasing with resuscitation with Normal saline to levels of 4 mM the values were slightly higher with LR resuscitation reaching levels of 5.0 mM. Bicarbonate levels were decreased after hemorrhage to average levels of 15mM and returned to higher levels by LR resuscitation as compared to Normal Saline resuscitation. The arterial pH was decreased after hemorrhage to average values of 7.21± 0.02 but returned to normal levels after Normal Saline resuscitation and LR resuscitation – figure 5,6.

Electrolyte concentrations of Na^+, K^+, Ca^{2+}, and Cl^- were measured during the entire period of study. The concentration

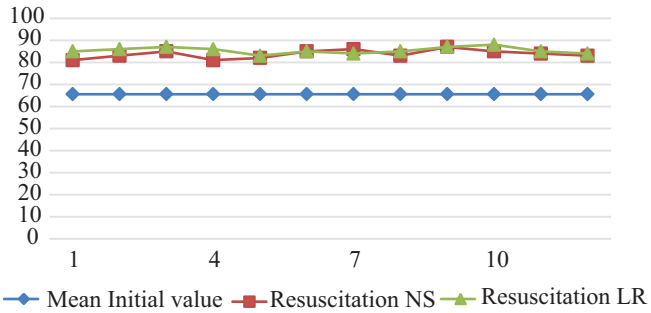

Figure-1: Mean Arterial Pressure MAP mmHg after hemorrhage and Resuscitation in both groups.

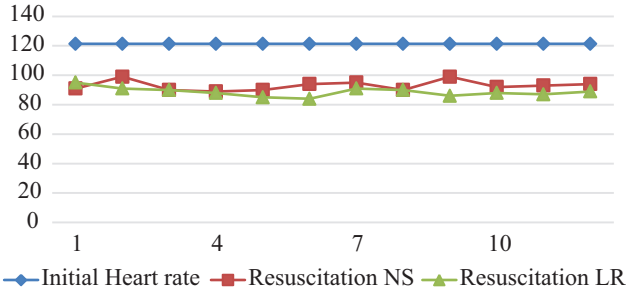

Figure-2: Heart Rate [BPM] recorded after hemorrhage and after resuscitation

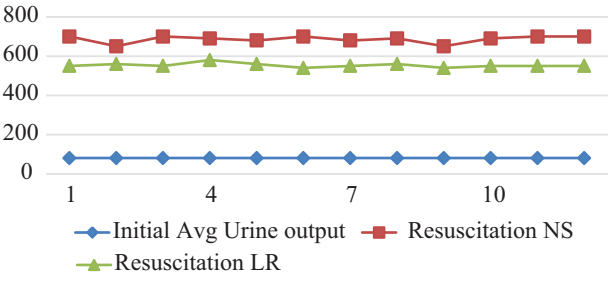

Figure-3: Urine output recorded after hemorrhage and resuscitation

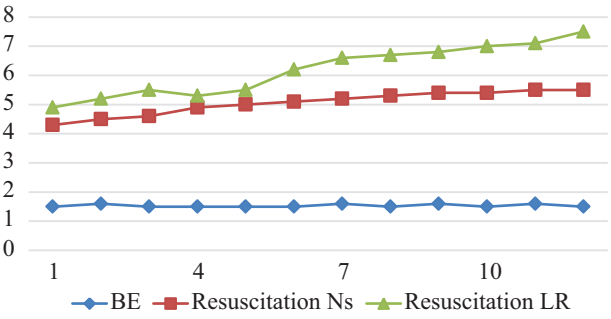

Figure-4: Base Excess recorded in hemorrhage and resuscitation

of Na^+ was 151.3 mM at 6 hours after Normal Saline resuscitation which was more than RL resuscitation of 145 mM the values were found to be significant. Similarly, the mean values of Ca^{2+} were 8.0 mM and 7.8 mM the values were significant. The mean values of chloride after 6 hours of resuscitation with NS were 122 mM and Ringer lactate was 101 mM the values were found to be significant (table-1).

DISCUSSION

Clinical decisions to administer i.v. fluids in the patients depend on the requirements of fluid and type of fluid to be infused.[21,22] Intravenous fluids have quantitative and

	After Hemorrhage	NS 1 hour	RL 1 hour	NS 6 hours	RL 6 hours
Mean Initial values of Na^+ in mM	138.5 ± 5.5	149 ± 2	143 ± 3	151.5 ± 3*	145 ± 5
Mean Initial values of K^+ in mM	4.8 ± 0.5	5.5 ± 0.3	5.3 ± 0.3	5.6 ± 0.3	5.2 ± 0.2
Mean initial values of Ca^{2+} in mM	7.5 ± 0.5	8.0 ± 0.3*	7.8 ± 0.4*	8.8 ± 0.4	8.4 ± 0.3
Mean initial values of Cl^- in mM	110 ± 8	119 ± 6	108 ± 5	122 ± 6*	101 ± 5

Table-1: Serum ion levels recorded during various intervals in subjects

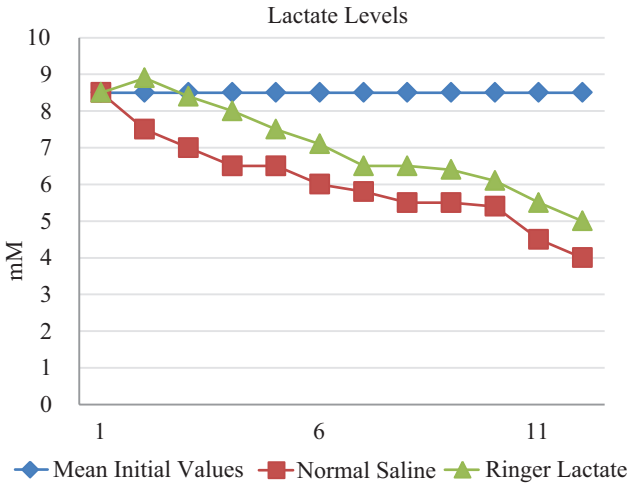

Figure-5: Base Excess recorded in hemorrhage and resuscitation

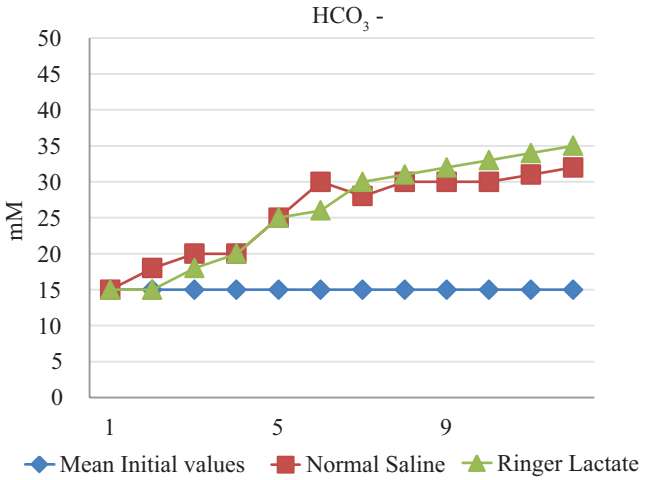

Figure-6: Bicarbonate recorded in hemorrhage and resuscitation

qualitative adverse effect depending up on the type of fluid and clinical settings. Recent evidence suggest that the choice of fluid replacement should be guided by patient specific factors. In the present study, we studied the effects of i.v. Normal saline and Lactate Ringer solution on the clinical parameters in trauma patients with mild to moderate blood loss. It was found that to achieve similar levels of MAP the amount of saline required was 50% more than LR. But the normal saline did not stay in vascular system as indicated by higher urine outputs. Several studies on animals and humans have shown that the infusion of moderate to large volumes of NS causes hyperchloraemic acidosis and cause greater interstitial oedema.[10-12] The low pH can itself potentiate cellular injury[20]. On the contrary, lactate in RL gets converted to bicarbonate ions in vivo and can improve pH, in addition to intravascular expansion. In our study, we found that mean chloride levels of the NS group increased significantly as compared to the LR group see figure the mean lactate levels of the NS group was also found to be higher than the LR group agreeing with the above authors. Hyperchloraemia can cause renal vasoconstriction and decreased renal artery flow velocity, blood flow, and cortical tissue perfusion decreased GFR and leads to salt and water retention.[15,23] Two studies done in humans comparing 0.9% saline with Ringer's lactate in the preoperative period have showed that 0.9% saline caused more undesirable side effects[24] There were significant changes in acid base balance observed in the study LR resuscitation returned BE and bicarbonate levels to the near baseline levels within 3 hours but the same was not observed with NS group even after 6 hours the findings were similar to animal study done by Wenjun Z Martini et al;[25] The impact of acid base on survival has been studied in animal model by Traverso et al;[26] When equal volume of resuscitation from NS, LR, and plasmalyte-A the last one having worst survival rate and pH from LR and Plasmalyte-A resuscitation were similar and higher than those from NS[26], suggesting a better acid base status was not necessarily attributable to a better survival.[25] Although the outcomes of NS versus LR are not clinically significant[16] patients in NS group were more acidotic. Healey et al using animal model found that NS and LR had equal survival rates in modern hemorrhage. But in massive hemorrhage LR resuscitation resulted in better survival.[27] It appears as if the apparent difference in outcomes from NS and LR becomes apparent only under extreme circumstances.

CONCLUSION

Ringer Lactate is found to be superior to Normal saline for fluid resuscitation because Normal saline has vasodilator effects with an increase in serum potassium levels and risk of metabolic acidosis. Although there were no significant differences found in the clinical outcomes, duration of admission and hospitalization between patients resuscitated with Normal Saline and Lactate Ringer solution.

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