Section: Anesthesiology and Critical Care

Original Research Article

COMPARISON OF THE EFFECT OF COMBINATION OF NORMAL SALINE & HALF NORMAL SALINE VERSUS NORMAL SALINE & LACTATE BASED BALANCED SALT SOLUTION ON ACID BASE STATUS AND ELECTROLYTE HOMEOSTASIS INTRA OPERATIVELY IN KIDNEY TRANSPLANTATION

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Abstract

Background: The objective is to quantify changes in acid-base balance, different electrolytes (sodium, potassium, chloride & bicarbonate) following administration of different combinations of IVF during renal transplantation. **Materials and Methods:** In this Prospective Observational study, patients were divided into two groups (n1=35, n2=39) to receive either combination of normal saline & half normal saline or combination of normal saline & ringer lactate during renal transplantation. Arterial blood gas sample analysed before induction of anesthesia, during vascular anastomosis, one hour after bladder clamp release and after extubation. blood urea and serum creatinine were measured before induction of anesthesia, immediately after surgery, one hour after extubation, urine output was recorded at one hour after bladder clamp release, one hour after extubation. **Result:** There was a statistically significant increase in the highest serum potassium level, highest chloride level and increase in the serum chloride measured at the end of study in patients who received combination of NS & half NS. No significant changes in Ph, Bcarbonate, sodium, lactate & urine output were seen with both the combination in either group. **Conclusion:** Combination of NS & RL is equally safe or possibly superior to combination of NS & Half NS for intraoperative use in renal transplantation.

INTRODUCTION

Acid base imbalance, electrolyte disturbances & hemodynamic instability are common in patients with chronic renal failure.[1] Fluid management constitutes an important aspect of renal transplant anaesthesia for the following reasons. Patients are usually on dialysis and are hypovolemic. While hypovolemia and underfilling can impair the perfusion of transplanted kidney, overzealous infusion of intravenous fluids can adversely affect myocardial contractility especially in patients with preexisting coronary artery disease and impaired left ventricular function. Thus maintenance of euvolemic status is strongly advisable.[2] The overall anesthetic goal for the newly transplanted kidney is to maintain intravascular volume and avoid decreased perfusion to the new kidney.[3]

Isotonic crystalloid solutions are the first choice for volume restoration during renal transplantation, but various crystalloid solutions can impact electrolyte & acid base balance differently.[4]

Normal saline (0.9% saline) is significantly hypertonic (Na 154mmol/l, Cl 154 mmol/l, osmolality 308mOsm/l) when compared to humen plasma & contains a very high content of chloride which can cause hyperchloremic metabolic acidosis. This acidosis may lead to decreased splanchnic perfusion, as judged by reduced urine flow & abdominal discomfort. Chloride ions regulate renal vascular resistance markedly within the clinical range.

Half normal saline (0.45% saline) has a lower sodium & chloride concentration & lower osmolality (Na 75mmol/l,Cl 75 mmol/l, osmolality 154 mOsm/l) compared to normal saline.

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Lactated Ringer's solution is moderately hypotonic (osmolarity 273 mOsm /L, Na 131mmol/l, K 5mmol/l,Ca 2 mmol/l,Cl 111 mmol/l, HCO3 29 mmol/l). While the chloride content is marginally higher than plasma chloride, the sodium content is marginally lower than plasma sodium & it also contains 5 meq / L potassium. Lactate in Ringer Lactate is rapidly metabolized to CO2 & water by the liver. The entry of lactate into the neoglucogenetic pathway may impair glucose homeostasis in diabetic patients.

Plasmalyte is a balanced salt solution having closest electrolyte constitution to plasma(Na 140mmol/l,K 5 mmol/l,Mg 1.5 mmol/l, Cl 98 mmol/l,Acetate 27, Gluconate 23,Osmolality 294 mOsmol/l). Transfusion of plasmalyte causes much less disturbance of acid base balance as compared to transfusion of sodium chloride – based fluids. This could be explained by the presence of weak acids, such as acetic acid, and gluconic acid. At pH 7.4 these acids are almost entirely in the base anion forms: acetate, and gluconate.

To avoid complications associated with the use of single type of intravenous fluids, combinations of intravenous fluids have been tried. In this study we have compared the combinations of Normal saline & half Normal saline versus Normal saline & Lactate based balanced salt solution for renal transplantation.

MATERIALS AND METHODS

This study was conducted among patients with end stage renal disease who underwent renal transplantation in lakeshore hospital. After obtaining ethics committee approval, a prospective observational trial will be conducted with patients undergoing renal transplantation. Duration of study was 12 months.

Inclusion Criteria

Patients with End stage disease for renal transplantation

Exclusion Criteria

1. Patients with known allergies to any of the intravenous fluids
2. Patients with severe left ventricular dysfunction as evidenced by echocardiogram with ejection fraction < 40% & pericardial effusion.
3. Patients with pre-existing coagulopathy as evidenced by deranged coagulation profile
4. Patients with preexisting anemia with Hb < 8 Gm%
5. Patients who are for preemptive transplants
6. Patients with pre operative hyperkalemia with serum potassium >5.5mEq/L
7. Patients with preoperative fasting blood glucose on the day of surgery of > 200 mg/dl

Method of collection of data: Patients were reviewed on the day prior to surgery and written informed consent was taken. On the day of surgery, on arrival to the preanesthetic room patients were allocated using computer generated card to either Group 1 or group 2.

Patient of group 1 received Normal saline and Half Normal saline alternately during the surgery and that of group 2 received Normal saline and Lactate based balanced salt solution alternately during the surgery. The principal investigator was unaware of the fluid combination used

Methodology: Eligible patients undergoing kidney transplantation were randomized to receive either saline based intravenous fluid (Normal saline & Half normal saline) alternately or saline based balanced salt solution (Normal saline & Ringer's Lactate) alternately. Preoperative values of serum electrolytes & renal function tests were noted.

On arrival to operation theatre, patients were connected to standard monitors-ECG, pulse oximeter & noninvasive blood pressure. Blood sample was sent for base line arterial blood gas (ABG) & serum electrolytes. Patients were induced with standard induction drugs like inj.Fentanyl, inj. Propofol or Etomidate and muscle relaxation was achieved with inj. Rocuronium. Patients were intubated with appropriate sized endotracheal tube orally & ventilated. Continuous end tidal carbon dioxide (ETCO2) & temperature monitoring was started. Anaesthesia was maintained with oxygen, inhalational agents, opioids, muscle relaxants & intermittent positive pressure ventilation (IPPV). Arterial cannulation was done & cardiac output monitoring was started using Vigilio flowtrac system. Central venous cannulation was done & CVP monitoring was started. Intravenous fluids were started at a maintenance rate of 4ml/kg/hr till the commencement of vascular anastomosis. Group 1 patients were given Normal saline & half Normal saline alternately and Group 2 patients Normal saline & Ringer's lactate alternately.

During the period of vascular anastomosis, intravenous fluids were given at a rate so as to maintain central venous pressure which is double the baseline or 20 mmHg and Cardiac output 8-12 L/min, whichever was lower. Serial Arterial blood gases & serum electrolytes were done at different stages of surgery (during vascular anastomosis, half an hour after vascular clamp release & after extubation). Vasopressors, inotropes, diuretics, blood & blood products were given at appropriate time at the discretion of the attending anesthesiologist.

At the end of the surgery, if the graft function was satisfactory (as evidenced by urine output of > 2ml/kg body weight in the first hour) & arterial blood gases were reasonable, patients were reversed with inj. Neostigmine & inj. Glycopyrrolate and were extubated.

Urine output, serum creatinine, blood urea & serum electrolytes were measured one hour after surgery & on postoperative day 1and 2 thereafter.

The variables / parameters recorded & studies during the study

Total volume of IVF (in ml) used during the study---

IVF pH before induction of anesthesia (baseline) $_{P}H_1$

pH during vascular anastomosis $_{P}H_2$

pH after bladder clamp release $_{P}H_3$

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pH one hour after extubation pH_4
Lowest ph found during the study pH_{low}
The decrease in pH from baseline pH_{dec}
Serum sodium before (in mEq/L) induction of anesthesia (baseline) Na_1
Serum sodium (in mEq/L) during vascular anastomosis Na_2 (in mEq/L)
Serum sodium (in mEq/L) one hour after extubation Na_3
The highest sodium (in mEq/L) recorded during the study Na_{high}
The increase in sodium (in mEq/L) from baseline during the study Na_{inc}
Serum potassium (in mEq/L) before induction of anesthesia K_1
Serum potassium (in mEq/L) during vascular anastomosis K_2
Serum potassium (in mEq/L) one hour after extubation K_3
Highest potassium (in mEq/L) found during the study—K_{high}
The increase in potassium (in mEq/L) from baseline during the study K_{inc}
Serum chloride (in mEq/L) before induction of anesthesia (baseline) Cl_1
Serum chloride (in mEq/L) during vascular anastomosis---Cl_2 Serum chloride (in mEq/L) one hour after extubation Cl_3
Highest chloride (in mEq/L) found during the study—Cl_{high}
The increase in chloride (in mEq/L) from baseline during the study Cl_{inc}
Serum bicarbonate (in mEq/L) before induction of anesthesia (baseline) $HCO_{3\ 1}$
Serum bicarbonate (in mEq/L) during vascular anastomosis $HCO_{3\ 2}$
Serum bicarbonate (in mEq/L) one hour after extubation $HCO_{3\ 3}$
Lowest bicarbonate (in mEq/L) found during the study-- $HCO_{3\ low}$
The decrease in bicarbonate(in mEq/L) from baseline during the study HCO_{3dec}
Blood lactate (in mmol/L) Lact
Preoperative blood urea (in mg/dl) (baseline)—BU_1
Blood urea (in mg/dl) one hour after surge BU_2
Blood urea (in mg/dl) on first postoperative day BU_3
Blood urea (in mg/dl) on second postoperative day BU_4
Decrease in blood urea (in mg/dl) at one hour after surgery from baseline BU_1BU_2
Decrease in blood urea (in mg/dl) on second postoperative day from baseline $BU_1\ BU_4$
Preoperative serum creatinine (in mg/dl) —SCr_1
serum creatinine (in mg/dl) one hour after surgey SCr_2
Serum creatinine (in mg/dl) on first postoperative day SCr_3
Serum creatinine (in mg/dl) on second postoperative day SCr_4
Decrease in serum creatinine (in mg/dl) at one hour after surgery from baseline SCr_1SCr_2
Decrease in serum creatinine (in mg/dl) on second postoperative day from baseline---- SCr_1SCr_4
Urine output (in ml) one hour after bladder clamp release---UO_1 Urine output (in ml) one hour after extubation UO_2
Urine output (in ml) on first postoperative day UO_3
Urine output (in ml) on second postoperative day UO_4

Primary outcome Measures

1. Electrolyte disturbances (sodium, potassium, chloride)
   - Hypernatremia that is serum sodium > 150 mEq/L
   - Hyperkalemia that is serum potassium > 5.5 mEq/L
   - Hyperchloremia that is serum chloride > 110 mEq/L
2. Acid base disturbances

Metabolic acidosis with blood pH of < 7.3 and serum bicarbonate < 22mmol/L

Secondary outcome measures:

- Blood urea, serum creatinine - preoperatively, one hour after surgery, postoperative day 1 & postoperative day 2
- Urine output –one hour after bladder clamp release, one hour after extubation, postoperative day 1 & postoperative day 2.

Sample size Calculation

Based on review of literature

A similar study was done in G.R. Doshi & K.M Mehta Institute of Kidney diseases & Research Centre and Dr.H.L Trivedi Institute of Transplantation sciences, Civil Hospital Campus, Asarwa, Ahmedabad state Gujarat, India., published in Saudi J Kidney Dis Transpl 2012; 23(1); 135-137 by name 'A Comparative Study of Impact of Infusion of Ringer's Lactate

Solution versus Normal Saline on Acid- Base Balance & Serum Electrolytes During Live Related Renal Transplantation.'

In this prospective randomized double blind clinical trial 74 patients were randomized into two groups containing 37 each.

Based on pilot study:

We did a pilot study of 10 cases in our hospital, randomized into two groups, each containing 5 cases. Out of many variables present in our study, we considered serum potassium level (S.K+). S.K+ measured at three different intervals during the study. With power (p) of 80% minimum difference of 0.54, 0.37 & 0.42 for three different values of k were obtained. Pooled difference calculated was 0.4, 0.71 & 0.47 respectively.

The three possible sample sizes obtained were 9, 78 & 20 respectively. Out of these we chose 78 as sample size for our study. This is very close to the sample size seen in previous study which is 74.

Statistical analyses: Sample size was 74 group 1 containing 35 & group 2 containing 39 patients. All the subjects completed the study.

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Descriptive statistics of measured variables were analysed and presented in terms of mean with standard deviation. Statistical significance was calculated using independent sample t-test Statistical significance was taken as p value < 0.05. The significance of difference between two groups was calculated with Chi-square test/Fischer Excat Test.

RESULTS

Considering demographic data with respect to age, body weight and sex distribution both groups were comparable.

Table 1: Demographic details.

Variables	Group 1	Group 2	p – value
Age	45.4 ± 11.89	41.9 ± 9.12	0.157
Weight	63.7 ± 14.22	63.2 ± 11.29	0.866
Sex	Group I	Group II	p – value
Male	26 (74.3%)	31 (79.5%)	0.595
Female	9 (25.7%)	8 (20.5%)	

Total volume of IVF used in intraoperative period: In group 1 3.99 ± 1.39 L of intravenous fluids were used intraoperatively & in group 2 4.22 ±1.16 L were used. The difference between the two groups was not significant (p=0.436).

Table 2: comparison of total volume of IVF used in group 1 and group 2

Variables	Group 1	Group 2	p – value
IVF	3.99 ± 1.39	4.22 ± 1.16	0.436

BLOOD pH: Baseline pH in group1 was 7.5 ± 0.05 & in group 2 it was 7.5 ± 0.07. Both groups were comparable (p=0.15).
Lowest pH found during the study in group 1 was 7.3 ± 0.05 & in group 2 it was 7.3 ± 0.04, The difference between two groups is not statistically significant as p=0.219.
The drop in pH seen during the study in group 1 was0.2 ± 0.08 & group 2 was 0.2 ± 0.06, The difference between two groups being statistically insignificant with p= 0.795.

Table 3: comparision of blood pH in group 1 and group 2

Variables	Group 1	Group 2	p - value
$_{p}H_{1}$	7.5 ± 0.05	7.5 ± 0.07	0.150
$_{p}H_{low}$	7.3 ± 0.05	7.3 ± 0.04	0.219
$_{p}H_{4}$	7.3 ± 0.06	7.3 ± 0.05	0.845
$_{p}H_{dec}$	0.2 ± 0.08	0.2 ± 0.06	0.795

SERUM Na^{+} LEVEL: Highest sodium level observed during the study (in mEq/L) was 140 ± 2.38 in group 1 & 141 ± 2.58 in group 2, the difference between the two groups being statistically insignificant with p= 0.212.
The increase in the serum sodium level (in mEq/L) in group 1 is 0.8 ± 1.41 & in group 2 it is 1.5 ± 1.97, the difference between two groups being statistically insignificant with p=0.092.

Table 4: comparision of serum Na+ level in group 1 and group 2

Variables	Group I	Group II	p - value
Na_{inc}	0.80 ± 1.41	1.49 ± 1.97	0.092
Na_{high}	140 ± 2.38	141 ± 2.58	0.212

Serum K+ level: Baseline potassium (in mEq/L) seen in group 1 is 7.02 ± 9.05 & group 2 is 4.34 ± 0.65 which is not statistically significant with p=0.069.
Highest potassium (in mEq/L) seen during the study was 5.0 ± 1.02 in group1 & 4.5 ± 0.63 in group 2. The difference between two groups was statistically significant with p=0.019.
Increase in potassium (in mEq/L0 during the study was 0.2 ± 0.34 in group 1 & 0.2 ± 0.21 in group 2, the difference between the two groups is not significant as p=0.351.
Serum potassium (in mEq/L) seen at the end of the study was 4.2 ± 0.64 in group 1 & 4.1 ± 0.52 in group 2, the difference between two groups is not significant as p=0.640.

Table 5: Comparision of Serum K+ Level In Group 1 And Group 2

Variables	Group 1	Group 2	p – value
K_{1}	4.81 ± 4.04	4.34 ± 0.65	0.069
K_{high}	5.0 ± 1.02	4.5 ± 0.63	0.019
K_{inc}	0.2 ± 0.34	0.2 ± 0.21	0.351
K_{3}	4.2 ± 0.64	4.1 ± 0.52	0.640

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Serum cl- level: Baseline chloride (in mEq/L) in group 1 is 101 ± 2.8 & in group 2 is103 ± 4.41 the difference between the two groups is significant as p=0.018.
The highest chloride (in mEq/L) found during the study in group 1 was 103 ± 2.78 & in group 2 it was 105 ± 3.68, the difference between two groups being significant as p=0.004.
The increase in blood chloride (in mEq/L) during the study was1.8 ± 2.30 in group 1& 1.8 ± 2.15 in group 2. But the difference between two groups is not statistically significant as p=0.886.
Chloride level (in mEq/L) seen at the end of the study in group 1 is 100 ± 3.95 & in group 2 it was 104 ± 3.68. they between the two groups is statistically significant as p=0.00.

Table 6: comparision of serum cl- level in group 1 and group 2

Variables	Group 1	Group 2	p - value
Cl_1	101 ± 2.8	103 ±4.41	0.018
Cl_{high}	103 ±2.78	105 ±3.68	0.004
Cl_{inc}	1.8 ± 2.30	1.8 ± 2.15	0.886
Cl_3	100 ±3.95	104 ±3.68	0.000

Serum bicarbonate level: Baseline bicarbonate (in mEq/L) recorded in group 1 is 23.6 ± 2.58 & in group 2 is 23.3 ± 2.89, the difference between the two groups being insignificant as p=0.618.
Lowest bicarbonate (in mEq/L) recorded during the study was 20.8 ± 1.69 in group 1 & 20.5 ±2.68 in group 2. The difference between two groups is not significant as p= 0.524.
The decrease in serum bicarbonate (in mEq/L) during the study in group 1 is 2.8 ± 2.04 & 2.8 ±2.32 in group 2.the difference between two groups is insignificant as p=0.973.
The bicarbonate level (in mEq/L) recorded at the end of the study in group 1 was 21.9 ± 2.10 & in group 2 was 20.9 ± 2.82.the difference between two groups being insignificant as p=0.085.

Table 7: comparision of serum bicarbonate level in group 1 and group 2

Variables	Group 1	Group 2	p - value
$HCO_{3\ 1}$	23.6 ± 2.58	23.3 ± 2.89	0.618
$HCO_{3\ low}$	20.8 ± 1.69	20.5 ± 2.68	0.524
HCO_{3dec}	2.8 ± 2.04	2.8 ± 2.32	0.973
$HCO_{3\ 3}$	21.9 ± 2.10	20.9 ± 2.82	0.085

Serum lactate level: Highest Serum lactate (in mmol/L) recorded during the study in group 1 is1.9 ± 1.07 & in group 2 it was p=0.19.
Blood urea level: Preoperative blood urea (in mg/dl) seen in group 1 was 39.2 ± 13.51 & in group 2 was 32.7 ±11.48 with p=0.029.
Blood urea level (in mg/dl) recorded immediate postoperatively was 50.1 ± 12.66 in group 1 & 39.1 ± 13.50 in group 2.The difference between two groups is statistically significant as p=0.001.
Decrease in blood urea level(in mg/dl) immediate postoperatively from baseline is -12.9 ± 12.12 in group 1& -6.44 ± 13.29 in group 2. The difference between two groups is /not statistically significant as p= 0.034.

Table 8: comparision of blood urea level in group 1 and group 2

Variables	Group 1	Group 2	p - value
BU_1	39.2 ± 13.51	32.7 ± 11.48	0.029
BU_2	50.1 ± 12.66	39.1 ± 13.50	0.001
BU_3	45.4 ± 13.76	39.5 ± 14.38	0.078
BU_4	60.7 ± 25.41	57.6 ± 30.63	0.639
BU_1 BU_2	-12.9 ±12.12	-6.44 ±13.29	0.034
BU_1 BU_4	-21.3 ±25.66	-24.9 ±30.29	0.578

Serum creatinine level: Baseline serum creatinine (in mg/dl) seen in group 1 was 5.1 ± 1.10 & 4.4 ± 1.19 in group 2 with p=0.009.
Serum creatinine (in mg/dl) recorded immediately after surgery was 5.1 ± 1.20 in group 1 & 4.3 ± 1.15 in group 2.the difference between two groups is significant as p= 0.004.
The decrease in serum creatinine (in mg/dl) immediately after surgery compared to the baseline was -0.01 ± 0.46. in gro p 1 & 0.07 ± 1.06 in group 2.the difference between the two groups is not statistically significant as p= 0.669.

Table 9: comparision of serum creatinine level in group 1 and group 2

Variables	Group 1	Group 2	p - value
SCr_1	5.1 ± 1.10	4.4 ± 1.19	0.009
SCr_2	5.1 ± 1.20	4.3 ± 1.15	0.004
SCr_3	3.7 ± 1.54	3.5 ± 1.06	0.384
SCr_4	2.9 ± 1.73	2.8 ± 1.35	0.722
SCr_1SCr_4	2.2 ± 1.51	1.6 ± 1.37	0.093
SCr_1SCr_2	-0.01 ± 0.46	0.07 ± 1.06	0.669

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Urine Output: Urine output (in ml) one hour after bladder clamp release was 967 ± 929 in group 1 & 686 ± 386 in group 2. The difference in two groups being statistically insignificant as p=0.087.

Urine output (in ml) one hour after extubation was 762 ± 739 in group 1 & 674 ± 432 in group 2. The difference in two groups is statistically insignificant as p=0.529.

DISCUSSION

Normal pH of blood is 7.35-7.45. For our study we defined acidosis as pH< 7.3. Although by definition acidosis was seen in 10 out of 35 i.e., 28.6% of patients in group 1 and in 7 out of 39 i.e.,17.9% of patients in group 2, the difference did not achieve statistically significant proportions (p=0.278).

Contrary results were seen in a study done by O'Malley et al in which normal saline & Ringer Lactate were used in each of the two groups. Eight (31%) patients of NS group were treated for metabolic acidosis compared to 0% in Ringer Lactate group.[5]

In a study by Necmiye et al patients of three groups received normal saline, Ringer Lactate & plasmalyte respectively. Significant decrease in pH was seen in normal saline group.[4]

In a study done by Dr.Manish P.Modi et al patients of two groups received normal saline & RL respectively. pH decreased from 7.43 to 7.33 in normal saline group & no change in normal saline group.[1]

In the studies mentioned above, the investigators used one type of intravenous fluid exclusively in each arm. That may explain the development of acidosis possibly secondary to hyperchloremia. In our study we used a combination of fluids in each arm, as a result there was no hyperchloremia.

It is also possible that the varying volumes of intravenous fluids used in the different studies have contributed to the varying results.

As we had used a combination of saline based fluids in one group and saline and lactate based fluids in the other group, hypernatremia was not seen in any patients in either group in the present study. The increase in serum sodium did not differ significantly among the two groups.

In a study by A. Ghorbani et al, half saline & a combination of NS & 1/3-1/2 intravenous fluid was administered to the renal transplant recepients postoperatively. The incidence of hyponatremia in the second group 2 was 11% (4 of 36 patients) & no patients in group 1.6

The combination of fluids used possibly resulted in development of hypoosmolar state

In a study by Laura Lehmann NS &HES vs RL & colloid in patients with subarachnoid hemorrhage (SAH), serum sodium levels increased in first group & no increase is seen in the other group. Both NS and HES contain 150 meq/L of sodium contributing to the development of hypernatremia. Here again the study population, the type of IVF used & the total volume administered differs from the present study.[7]

During our study, serum potassium levels over 5.0 mEq/L were recorded in group 1 but not in group 2. This rise in serum potassium was not sustained as the increase in serum potassium during the study & the serum potassium level seen at the end of the study did not differ significantly among the two groups. For most of the patients, the highest potassium level was seen at the start of the study, thus making its significance questionable.

In a study by O'Malley and colleagues, one group of patients undergoing renal transplantation received RL & the other received NS.19% of patients in NS group versus 0% in RL group had serum potassium levels > 6mEq/L & were treated for hyperkalemia.[5]

In a study by Necmiye et al in which renal transplant recipients received either NS or RL or plasmalyte, serum potassium levels were not significantly changed in any group.[4]

Our study is similar to the above-mentioned studies in study population although the amount & the type of IVF administered is different. We strongly feel that the combination of intravenous fluids used prevented the development of clinically significant hyperkalemia.

Serum chloride levels are of special concern in renal transplant recipients as its high level can affect the graft function by altering renal vascular resistance.

In our study although the two groups differed in their baseline serum chloride levels, serum chloride level remained similar at the end of the study between the two groups.

The study by O'Malley et al compared the effects of ringer lactate and normal saline in renal transplant recipients. Serum chloride concentration at the end of surgery was 111+/- 4 meq/L in NS group verses 106+/-4 meq/L in RL group, the difference between the two groups being statistically significant.[5]

Similarly, a study by Necmiye Hadimioglu and group demonstrated a significant increase in serum chloride in the NS group among three groups of patients receiving NS, RL & plasmalyte respectively.[4]

In a study by done by Dr Manisha P Modi et al showed stable serum chloride levels in both NS & RL groups.[1]

The present study differs from those mentioned above in terms of type & the amount of intravenous fluid used although the study population remains the same.

The decrease in serum bicarbonate during the study was not significantly different among the two groups. The lowest serum bicarbonate found during the study & that found at the end of study were similar among both the groups.

In a study by O'Malley et al even though baseline bicarbonate was not significantly different in NS & RL, there was a significant difference in lowest bicarbonate found intra operatively & that found at the end of the surgery. It was low in NS group compared to RL group.[5]

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The study by Necmiye et al showed statistically significant decrease in base excess in NS group compared to RL & plasmalyte group.[4]
The study by Dr Manisha P Modi, showed a statistically significant fall in base excess from -2.73 to -4.97 with a decrease in bicarbonate level.[1]
The findings in present study were contrary to those found in the above mentioned studies. We attribute this to the combination of fluids used in present study. A combination of NS & RL is safer than NS alone in terms of maintaining serum bicarbonate.
Serum lactate measured during the study was similar in both the groups.
Study by Necmiye et al showed statistically significant, progressive increase in lactate levels (0.48-1.95Mm/l) without a change in pH in RL group. Lactate was not significantly changed in NS & plasmalyte group.[4]
Findings of present study are contrary to what was found in the above mentioned study. It can be attributed to the combination of fluids used in our study as compared to single type of fluid used in the other. This lends further strength to our hypothesis that a combination of RL & NS is safer than NS alone & is similar to RL & Plasmalyte alone in terms of maintaining serum lactate concentration. But we measured serum lactate intraoperatively only and not in the postoperative period.

CONCLUSION

A combination of saline and lactate based balanced salt solution is ideal and perhaps safer than saline based solutions alone when used as intraoperative fluid therapy during renal transplantation. The electrolyte and acid base milieu is better preserved with this combination fluid therapy. While the concerns about hyperkalemia with the use of balanced salt solutions in this setting are unfounded, acidosis & subsequent hyperkalemia with the use of saline solutions alone are real entities.
In addition, the combination fluid therapy does not seem to adversely affect the functioning of the new renal graft.

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