Section:Anesthesiology

Original Research Article

TO STUDY THE EFFECTS OF INTRAVENOUS FLUIDS GIVEN INTRAOPERATIVELY ON GRAFT FUNCTION POSTOPERATIVELY IN KIDNEY TRANSPLATATION

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ABSTRACT

Background: To study the effects of intravenous fluids given intraoperatively on graft function postoperatively**.**

Materials and Methods: In this double blind study, patients were randomized into two groups (n_1=35,n_2=39) to receive either combination of normal saline & half normal saline or combination of normal saline & ringer lactate during renal transplantation. Arterial blood gas analyses were performed before induction of anesthesia, during vascular anastomosis, one hour after bladder clamp release and after extubation. Blood urea and serum creatinine were measured on first postoperative day and on second postoperative day. Urine output was recorded on first & second postoperative days.

Results: 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. Statistically significant increase in blood urea & serum creatinine was seen in immediate postoperative period in patients who received combination of NS & Half NS.

Conclusion: Serum creatinine was higher in group 1 than in group 2 preoperatively & immediate postoperatively. However the decrease in serum creatinine from baseline level to immediate postoperative level and that measured on first & second postoperative day were similar in both the groups.

Keywords: Intravenous fluids, Renal transplantation, Acid-base balance, postoperatively.

INTRODUCTION

The type of intravenous fluid we use intraoperatively is also of great importance. Crystalloids are satisfactory for volume maintenance during renal transplantation as they carry no infectious risks and are not nephrotoxic.[4] Colloids may be considered in recipients with severe intravascular volume deficits who require high volume resuscitation.[3] Albumin has the widest safety margin among the available colloids but the high cost precludes its liberal use. Synthetic colloids that have widely replaced albumin in clinical practice elsewhere such as dextran, gelatins and solutions of hydroxyethyl starch (HES) are not preferable over albumin in renal transplantation. Colloids such as HES have been reported to adversely affect renal function and may increase bleeding complications. The high potassium & calcium content of older gelatins (eg: hemaccel) render them unsatisfactory for perioperative use during renal transplantation. Dextran solutions have been associated with severe hypersensitivity reactions and coagulation problems. Lower molecular weight hydroxyethyl starch (HES), although a synthetic colloid can be an alternative to Albumin.[3]

0.9% saline infusion leads to metabolic acidosis by both dilution of plasma bicarbonate by large volumes of buffer free fluid and hyperchloremia decreasing the strong ion difference.[5] Irrespective

of the mechanism, the acidosis is of particular significance in patients undergoing renal transplantation who often have preexisting acidosis due to ESRD.[1] Hyperchloremic metabolic acidosis is less common during with administration of half normal saline, however dilutional hyponatremia may occur with large volume administration.[6]

Ringer's Lactate is also not an ideal solution during renal transplantation as use of large volume of the same can lead to dyselectrolytemia, hyperglycemia & possibly hyperlactatemia.[2]

Acetate and gluconate present in 'balanced salt solutions like plasmalyte' act as bicarbonate precursors, the conversion occurring predominantly in the liver, although acetate may be converted to bicarbonate in other tissues. Furthermore, the lower chloride content of plasmalyte tends to attenuate the reduction in the posttransfusion strong ion difference compared with saline infusion.[4]

Hence this study was conducted to study the effects of intravenous fluids given intraoperatively on graft function postoperatively.

MATERIALS AND METHODS

This study was conducted among patients with end stage renal disease who have undergone renal transplantation in lakeshore hospital. After obtaining ethics committee approval, a randomized trial was conducted with patients undergoing renal transplantation in one year duration

Sample Size: 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.

Inclusion Criteria

1. Patients with End stage kidney 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 randomized with 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 Ringer Lactate based balanced salt solution alternately during the surgery.

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, relaxed muscle relaxation 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: air: sevoflurane, 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 vascular anastomosis, intravenous fluids were given at a faster rate so as to maintain central venous pressure which is double the baseline or 20 mmHg and Cardiac output 8-12 L/min, whichever is lower. Serial Arterial blood gases & serum electrolytes were done at different stages of surgery that is 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.

Statistical Analyses

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

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 Exact Test.

RESULTS

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

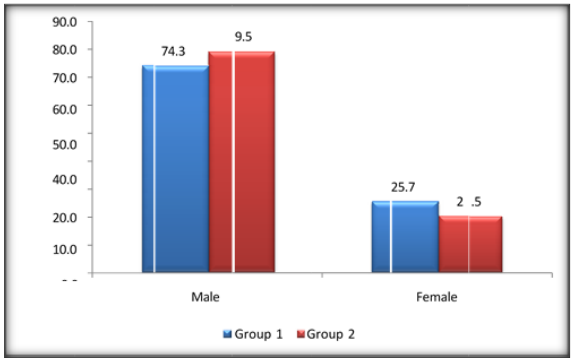

Figure 2: Comparision of sex distribution in group 1and group 2

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).

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 lood 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.

Blood urea level (in mg/dl) seen on first postoperative day was 45.4 ± 13.76 in group 1& 39.5 ±14.38 in group 2. The difference between the two groups is statistically insignificant as p=0.078.

Blood urea level (in mg/dl) recorded on second postoperative day in group 1 was 60.7 ± 25.41 & in group 2 it was 57.6 ± 30.63.the difference between the two groups is statistically not significant as p=0.639.

The decrease in blood urea level (in mg/dl) on second postoperative day from baseline is -21.3 ± 25.66 in group1 & -24.9 ± 30.29 in group 2.the difference between two groups is statistically not significant as p=0.578.

Table 1: 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_1BU_2	-12.9 ± 12.12	-6.44 ± 13.29	0.034
BU_1BU_4	-21.3 ± 25.66	-24.9 ± 30.29	0.578

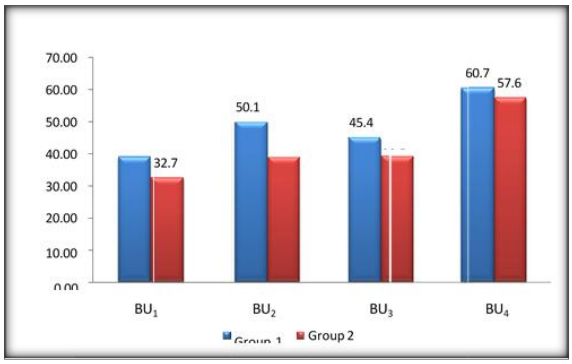

Figure 3: Comparision of blood urea level in group 1 and group 2

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.

Serum creatinine (in mg/dl) seen on first postoperative day was 3.7 ± 1.54 in group 1& 3.5 ± 1.06 in group 2.the difference between two groups is not significant as p= 0.384.

Serum creatinine (in mg/dl) recorded on second postoperative day was 2.9 ± 1.73 in group 1 & 2.8 ± 1.35 in group2. The difference between two groups is not significant as p=0.722.

The decrease in serum creatinine (in mg/dl) on second postoperative day from baseline in group 1 was 2.17 ± 1.51 & 1.59 ± 1.37 in group 2 the difference between two groups being statistically not significant as p=0.091.

Table 2: Comparision of serum creatinine level in group 1 and group 2urine output

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

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 between two groups is statistically not significant as p=0.529.

Urine output in ml) on first postoperative day was 6973 ± 4347 in group 1 &6370 ± 3709 in group 2.the difference between the two groups was not statistically significant as p=0.522.

Urine output (in ml) on second postoperative day was 5648 ± 2918 in group 1&6064 ± 4094 in group 2.the difference between t\wo groups is statistically not significant as p=0.620.

Table 3: Comparision of urine output in group 1 and group 2

Variables	Group 1	Group2I	p - value
UO_1	967 ± 929	686 ± 386	0.087
UO_2	762 ± 739	674 ± 432	0.529
UO_3	6973 ± 4347	6370 ± 3709	0.522
UO_4	5648 ± 2918	6064 ± 4094	0.620

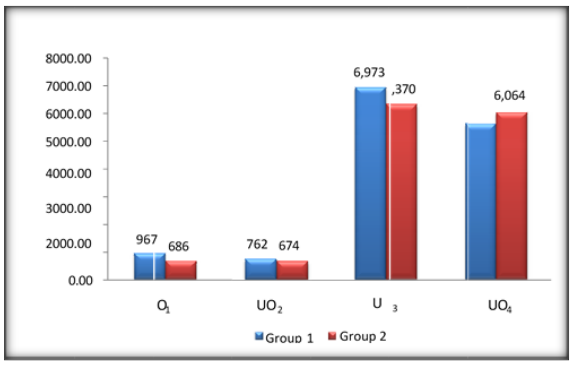

Figure 4: Comparision of urine output in group 1 and group 2

DISCUSSION

Because of the improvements in medical science & technology, renal transplantation is commonly being done for many patients with end stage renal disease. Renal transplant anesthesia is complex & needs a thorough understanding of the metabolic & systemic abnormalities in ESRD, familiarity with transplant medicine & expertise in managing & optimizing these patients for the best possible outcome. Intravenous fluid administration is an integral part of anesthesia. The volume, the type and the timing of IVF administration during renal transplantation is a key component of transplant anesthesia.

Normal saline and Ringer lactate are commonly used intravenous fluids because of their safety & low cost. As the volume used during renal transplantation is usually large, their safety becomes questionable. NS was the IVF of choice for many years for renal transplantation. But when used in large amounts it is known to cause hyperchloremic metabolic acidosis. Both acidosis & hyperchloremia have adverse effect in these patients.

Ringer Lactate which contains 5mEq/L potassium was thought to be unsafe as the diseased kidney cannot excrete potassium and end stage renal disease patients usually have high potassium levels. Lactate in Ringer Lactate may contribute to acidosis which is usually seen in renal failure patients.

Many anesthesiologists use combination of different type of intravenous fluids to avoid the adverse consequences of single type of intravenous fluids specially when used in large amount. In this study we have used a combination of saline based and saline & lactate based balanced salt solution.

All our patients in both groups started passing urine following vascular anastomosis and none required mechanical ventilation or renal replacement therapy in the postoperative period. Thus neither combination of fluids resulted in adverse renal outcomes.

Preoperatively all patients underwent hemodialysis for three consecutive days prior to surgery possibly providing the explanation for low blood urea levels on the morning of surgery.

Blood urea was marginally higher in group 1 than group 2 to start with & it remained high in the immediate postoperative period. Both groups showed higher blood urea levels in the postoperative period despite satisfactory urine output though the difference between the two groups was comparable.

In the study by Necmiye et al, there was no significant difference in BUN seen during post-operative day 1,2 3 & 7 between NS, RL & plasmalyte group.[4]

The findings in present study & one quoted above are different. Normal saline, half normal saline and Ringer lactate are not known to directly affect blood urea production. It is possible that other factors may be involved in the aetiology of the elevated postoperative blood urea levels.

Baseline serum creatinine was higher in group 1 than in group 2 & also in immediate postoperative period. The significance of this is questionable as the decrease in serum creatinine from baseline level to immediate postoperative level and that measured on first & second postoperative day were similar in both the groups in the present study.

During the study, urine output recorded at different time intervals was similar in both the groups. This is contrary to the observation by O'Malley et al, where it was found that the cumulative postoperative urine output was larger in NS group than in RL group.

CONCLUSION

Serum creatinine was high in group 1 than in group 2 preoperatively & immediate postoperatively. However the decrease in serum creatinine from baseline level to immediate postoperative level and that measured on first & second postoperative day were similar in both the groups.

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