Comparison of Restrictive Fluid Therapy versus Conventional Fluid Therapy on Renal Indices in Patients undergoing Major Abdominal and Gynaecological Surgeries: Experience in Tertiary centre experience

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ABSTRACT

Background: During major abdominal and gynae cological surgeries, perioperative fluid administration is done to ensure optimal oxygen supply andtissue perfusion. Concentratedurine is produced in restricted fluidtherapy to decreaseavail ability of water. Kidneys create and maintain osmoticgradient by which kidneys become increasingly concentrated from the cortextothemedulla.Restrictive fluid the rapyinabdominal surgery patientsis associated with rapid return of bowel function, fewer complication sand short erhospital stay.

Materials and Methods: In order to compare the effects of restricted fluid therapy to conventional fluid therapy on changes in renal functions among patients undergoing major abdominal or gynaecological surgeries, a prospective study was conducted in the department of anaesthesia at a tertiary care hospital in South India. It included 50 adult patients (18 years old) of either sex who were undergoing elective major abdominal & gynaecological surgeries.Patients were randomly assigned to either the restrictive fluid or conventional fluid groups in this pragmatic, single-blind study.

Results:

In preoperative period, mean serum cystatin C level was similar in both the groups, but restricted group showed higher mean serum cystatin C levels during post-operative period and both the groups showed statistical significance on comparison.

Conclusion:

Prior to surgery, between two groups, there was no significant difference for primary renal function outcomes and electrolyte levels. Post-surgery, mean serum urea, creatinine were comparable in both the groups, Serum cystatin c levels were higher in restrictive group.

Keywords: Cystatin C, creatinine, urea, Glomerular filtration rate.

INTRODUCTION:

To ensure ideal tissue perfusion and oxygenation during major abdominal and gynaecological procedures, perioperative fluid administration is used. Due to the excessive use of intravenous fluids, weight increase of between 3 and 6 kg has been noted as well as tissue oedema.Following extensive usage of intravenous fluid therapy, it has been seen that the incidence of pulmonary morbidity, decreased coagulation, bacterial translocation, sepsis, and poor wound healing has increased.[1] In anaesthetic treatment, spinal anaesthesia is a frequently employed approach for gynaecological, lower abdominal, pelvic, and lower limb procedures. For treatments lasting two to two and a half hours or longer, bupivacaine, a long-acting amide, is suitable. To extend the time of operation, intravenous anaesthetics such as clonidine and dexmedetomidine, phenylephrine, adenosine, magnesium sulphate, and neostigmine can be utilised. Crystalloid losses in the third space can be partially replaced by intravenous fluid infusion[2].

Liberal volumes of intravenous fluids are administered in perioperative period to reduce preoperative dehydration, circulatory instability associated with general and regional anaesthesia and inadequate tissue oxygen delivery (especially to the bowel), unnecessary blood transfusion and low urine output.[3] Additionally, it makes up for fluid deficits caused by preoperative fasting and other factors, anaesthesia-induced vasodilation, haemorrhage, and fluid build-up in extravascular areas, as well as improving tissue oxygen delivery and maintaining urine output. Haemodilution after fluid administration during the perioperative period reduces renal oxygenation, which impairs renal function.[4]

Organ dysfunction and shock are caused by hypovolemia, which impairs circulation and reduces the oxygen delivery to numerous organs and peripheral tissues.

Interstitial edoema and local inflammation are brought on by fluid accumulation. Additionally, it decreases the ability of collagen to regenerate, which slows tissue healing and

increases the risk of wound infections, wound rupture, and anastomotic leaking. Cardiopulmonary function may also be impacted by fluid excess[5].

MATERIALS AND METHODS

It is a prospective study was conducted in the department of anaesthesia at a tertiary care hospital in South India done to compare the effects of restricted fluid therapy to conventional fluid therapy on changes in renal functions among patients undergoing major abdominal or gynaecological surgeries,. It included 50 adult patients (18 years old) of either sex who were undergoing elective major abdominal & gynaecological surgeries between August 2017 and August 2018.Patients were randomly assigned to either the restrictive fluid or conventional fluid groups in this single-blind study. When the patient arrived in the 0T, baseline measurements (HR, BP, Spo2, and ECG) were taken. Following adequate pre-oxygenation, general anaesthesia was induced using Fentanyl (2 mcg/kg), Propofol (1-2 mg/kg), and Vecuronium (0.10 mg/kg). The patient was then intubated using the correct size of an endotracheal tube (ET tube), placed on intermittent positive pressure ventilation with a tidal volume of 7-10 ml/kg, sevoflurane was used for maintaining anaesthesia.Fluid responsiveness was determined using sophisticated monitoring techniques such invasive blood pressure measurement, central venous pressure monitoring, and pulse pressure variation (PPV). Patients who required urgent or time-critical surgery, had an ASA physical status of 5, had liver resections, needed minor or intermediate surgery, or had chronic renal failure requiring dialysis were excluded from the study.

Patients over the age of 70, those with a history of coronary artery disease, heart failure, diabetes currently being treated with an oral hypoglycaemic medication and/or insulin, those with morbid obesity (body mass index [BMI] 35 kg/m2), those with preoperative serum creatinine levels above 200 mol/L (> 2.8 mg/dL), those with preoperative serum albumin levels below 30, those with anaerobic threshold (if performed), and those with two or more Anaerobic threshold (if done) 12–14 mL/kg/min, preoperative serum creatinine 150–199 mol/L (>1.7 mg/dL), and preoperative haemoglobin <100 g/L.The study groups were split into two groups: the conventional (or "standard practise") intravenous fluid group received balanced salt solution as an 8 mL/kg/hour infusion until the end of operation after receiving a 10 mL/kg bolus of the fluid. Following that, a maintenance infusion that was adjusted based on blood pressure was continued for at least 24 hours at a rate of 1.5 mL/kg/hour.The intravenous fluid bolus provided as part of the restrictive group's hydration regimen was capped at 5 mL/kg at induction. A postoperative infusion rate of 0.8 mL/kg/hour was used until the end of intravenous fluid therapy within 24 hours. Balanced salt crystalloid was

administered at a rate of 5 mL/kg/hour as an infusion up until the conclusion of surgery, and bolus colloid/blood was used intraoperatively to replace blood loss (mL for mL).The institutional ethical committee granted the necessary approval. written informed consent following a thorough pre-anesthetic examination.

The IBM Statistical Package for Social Sciences, version 21.0, was used to analyse the data. For qualitative data, the Chi-square test was employed, and for continuous data, the Independent Samples' T-test. The Paired't'-test was used to evaluate within-group changes in study parameters between pre- and post-operative intervals.A "p" value less than 0.05, which indicates a likelihood of chance error of 5%, was considered statistically significant. The study's confidence level was maintained at 95%. Data for the study was gathered on paper using a case report form, which was afterwards typed into an excel database. Regular checks were made for data integrity, the assessment and interpretation of accumulating data, and the trial participants' safety.

RESULT:

Table 1: Demographics in present study

Age range(Years)	**Number of patients**	**Percentage**
Less than 20	5	10%
21-30	3	6%
31-40	7.5	15%
41-50	7.5	15%
51-60	20	40%
Greater than 60	7	14%
Sex		
Conventional therapy group		
Males	20	40%
Females	30	60%
Restricted therapy group		
Males	25	50%
Females	25	50%

Table 1 shows that that 10% of patients were in the age group of less than 20, 70% of patients were in the age group of 31 to 60 years and 14% of patients were in the age of greater than 60 years. Mean age of the patients was 48.19±18.24. In conventional therapy group, the females

were more when compared to males, however, in restricted therapy group, the sex distribution was same. This difference was not statistically significant even though more females were observed in conventional therapy group when compared to restricted therapy group.

Table 2: Body weight and height distribution

Group	Body weight (kg)	Height (cms)
Conventional therapy group	39 to 75	150 to 177
Restricted therapy group	42 to 85	147 to 175

Table 2 shows that body weight and height in conventional therapy group were 39 to 75 kgs and 150 to 177 cms respectively and that in restricted therapy group were 42 to 85 kgs and 147 to 175 cms respectively. However, the difference in body weight and height was not statistically significant.

Table 3: Body mass index distribution

BMI (Kg/m^2)	Number of patients	Percentages
Restricted therapy group		
Normal	38	76%
Underweight	7	14%
Overweight	3	6%
Obese	2	4%

In conventional therapy group, BMI ranged from 14.45 to 25.98 kg/m^2 and none were obese. In restricted therapy group, 76% of patients were normal, 14% of patients were underweight, 6% were overweight and 4% were obese. BMI ranged from 14.45 to 32.65 kg/m^2. Mean BMI of patients was slightly higher in restricted therapy group when compared to that of conventional therapy group. However, the difference between the two groups was non-significant.

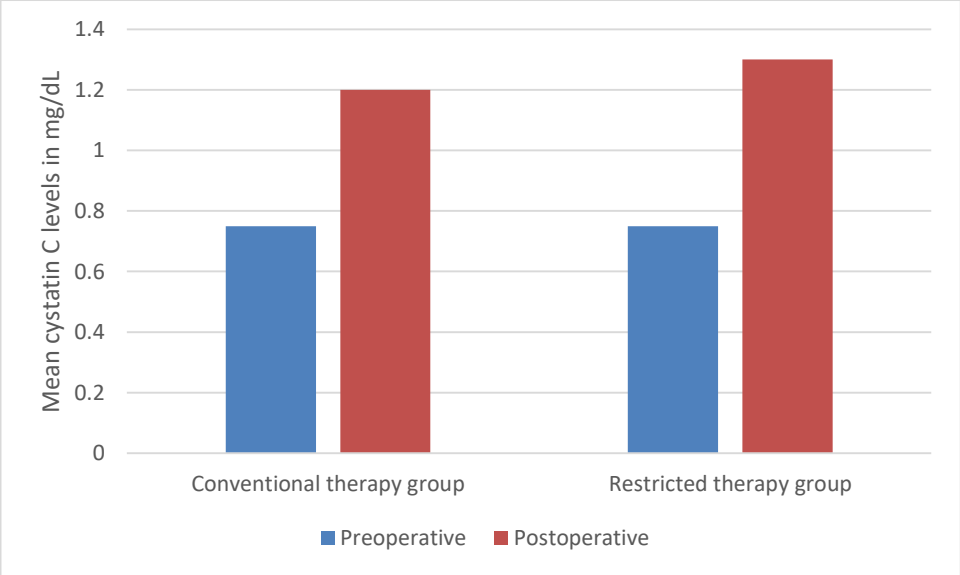
90% of patients had ASA Grade I and 10% of patients had ASA Grade II. However, ASA grade II patients were higher in restricted therapy group (11%) when compared to that of conventional therapy group (6%), but when both were compared, it was statistically non-significant. 75% of procedures were abdominal surgeries and only 25% were gynaecological surgeries in both the groups.

At preoperative and postoperative time intervals, mean blood urea levels were 24.39±6.32 and 23.85±2.49 mg/dl respectively in conventional therapy group and in restricted therapy group, mean blood urea levels were 21.56±5.49 and 23.11±9.28 mg/dl respectively. Thus,

conventional therapy group had higher mean blood urea levels when compared to that of restricted therapy group, however, the level of significance was non-significant.

Mean serum creatinine levels were higher in conventional therapy group when compared to that of restricted therapy group, preoperatively but it was vice versa in postoperative. A decline of 28% in mean value was observed in conventional therapy group during post-operativeperiod, however, in restrictive group, an increase of 1.4% in mean serum creatinine values on post-operative period, but on comparison of both the groups, the difference was non-significant.

Figure-1: Comparision of Cystatin C levels in both groups at pre and postoperatively



In preoperative period, mean serum cystatin C level was similar in both the groups, but restricted group showed higher mean serum cystatin C levels during post-operative period and both the groups showed statistical significance on comparison.

In preoperative period, Restricted group showed higher mean serum sodium levels, mean serum potassium levels, mean serum chloride levels, however, during postoperative period, conventional therapy group showed higher mean sodium values, mean potassium values, mean chloride values. Comparison of both the groups showed non significance. A decline of 6% in mean change of serum potassium levels between preoperative and postoperative periods value in conventional therapy group and it was statistically significant. A decline of 11% in mean change of serum potassium levels between preoperative and postoperative periods value in restricted therapy group and it was statistically significant.

An increase of 2.2% in mean change of serum chloride levels between preoperative and postoperative periods value in conventional therapy group and it was not statistically significant. An increase of 0.5 % in mean change of serum chloride levels between

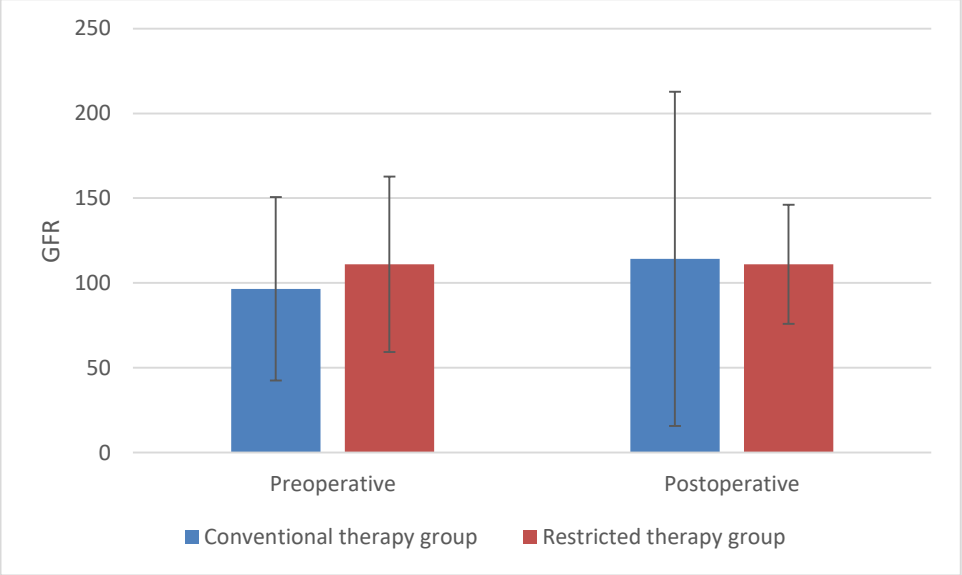
preoperative and postoperative periods value in restricted therapy group and it was not statistically significant.

Table-4: Preoperative and postoperative eGFR (C&G) comparison and its change during the period between two groups.

Interval	Conventional therapy group	Restricted therapy group
Preoperative	96.58±54.11	111±98.5
Postoperative	114.29±51.87	111±35.17

Table 4 shows that in restricted therapy group, mean eGFR level was higher when compared to that of conventional therapy group in preoperative and postoperative period. On comparison between two groups, statistically non significance was observed.

Figure-3: GFR comparison and its change during the period between two groups.



There was no adverse effect observed due to fluid therapy which give rise to infectious, pulmonary, cardiac, gastrointestinal or renal complications in either of the groups and there was no mortality observed in both the groups postoperatively.

DISCUSSION

In order to prevent dehydration or hypovolemia, perioperative fluid therapy assists in maintaining or correcting fluid balance. It also maintains appropriate circulation by utilising vasoactive and/orcardioactive chemical that ensures proper organ oxygen delivery. By keeping the electrolytes in balance, it preserves plasma composition. Dynamic adjustments in the kidneys' water excretion in response to fluid intake maintain plasma osmolality.In order to minimise the amount of water available, restricted fluid therapy creates concentrated urine.

Kidneys, which become increasingly concentrated from the cortex to the medulla, are responsible for creating and maintaining the osmotic gradient. The renal osmotic gradient is maintained by the loops of Henle and the collecting ducts in a counter-current manner, allowing for the reabsorption of the majority of the water that flows through the kidney.[6] Acute kidney injury's unfavourable renal outcome is influenced by the dose, type (colloid vs. crystalloid), and balance of crystalloids and colloids. Pulse pressure variation, stroke volume variation, or other dynamic indicators of fluid responsiveness are appropriate for estimating fluid requirements.Liberal fluid delivery can cause alveolar capillary edoema, which negatively impacts renal function by decreasing gas exchange and generating an acid-base imbalance. In contrast, modest fluid restriction improves renal parameter results. Restrictive fluid therapy is linked to a quicker recovery from abdominal surgery, fewer complications, and a shorter length of stay in the hospital[7].3000 patients underwent major abdominal procedures as part of the RELIEF experiment, and those patients were scheduled to remain in the hospital for at least two hours. A minimum 3-day stay and an elevated risk of complications was observed. Contrast to the present study, Sahmeddini et al[8] study was conducted on a study population with a mean age of 26.4 years and a majority of male (64.2%) patients undergoing liver transplant surgery, demonstrating that despite the younger age of the patients, they had patients with a specific high-risk, more complicated surgery. Despite having a male predominance and a mean patient age that was 5 to 15 years older than our study's and only including patients with ASA I/II, Sujatha et al.[9] and Cesur et al [10]study .'s included only ASA I/II patients.Patients in the present study had better surgical grades than those in all of these studies, which reduced the likelihood of post-operative complications. Regarding age, gender, BMI, grade and type of surgery, and renal functions, no statistically significant difference between the two groups was found in the present study.

Apart from the electrolytes Na+, K+, and Cl tested in the pre-intervention period, the main renal functions evaluated were mean blood urea, serum creatinine, and serum cystatin C levels. These primary renal function outcomes and the electrolyte levels in the two groups did not differ statistically significantly.Cystatin C has been identified in a number of clinical settings as an early indication of compromised renal function and acute kidney damage[11]. A non-glycosylated protein with cysteine proteinase inhibitory action is called cystatin C. All nucleated cells have been proven to produce it at a constant rate, and changes in glomerular function rate are shown to be inversely correlated with changes in serum cystatin C levels. Therefore, it is thought that measuring serum cystatin C levels can provide a more accurate

assessment of kidney function. Our results concur with earlier research by Chew JS et al[12]., who also reported comparable mean creatinine values. In the current study, globular function rate was calculated using two different techniques. Our initial approach was based on the second approach we utilised was based on combination and used serum creatinine as the basis for calculation (C&G formula).serum levels of cystatin C and creatinine. The conventional group's intervention estimated GFR values were lower in contrast to the restricted group's estimates using the C&G formula and the CKD-EPI formula based on Cystatin C and S. creatinine. In comparison to the current study, John F. et al.[13] reported a greater GFR, indicating superior preoperative renal function. In our investigation, post-operative mean blood urea and creatinine levels were comparable in both groups. Despite the fact that the restrictive group was found to have higher serum cystatin C levels, there was a statistically significant difference in cystatin C levels between the two groups.Although there was no statistically significant difference in post-fluid therapy electrolyte levels between the two groups in our investigation, mean values of electrolytes Na+, K+, and Cl- levels were noted to be higher in the traditional group. In comparison to the current study, John F. et al. [13]reported a greater GFR, indicating superior preoperative renal function. Although it was noted that the conventional group had higher estimated GFR values based on the C&G formula and the CKD-EPI formula based on Cystatin C and S. creatinine, this did not reach statistical significance when compared between the two groups. Elevated cystatin C levels are an early sign of acute kidney injury and a sign of decreased renal function.[14] Serum Cystatin C levels in our study's restrictive therapy group were found to be greater than those in the conventional therapy group, indicating a higher risk of AKI to be related with restrictive therapy. Myles et al.[15] reported a higher incidence of AKI in restrictive therapy group (8.6%) as compared to that in conventional therapy group (5%), although there was no incidence of AKI due to Inclusion of patients with relatively better grade of surgery (ASA grade) in present study which reduced the rate of adverse renal outcomes like AKI. Less fluid delivery resulted in a decreased incidence of AKI, according to Shin et al.[16] Compared to serum creatinine and other renal function parameters studied, cystatin C is unquestionably a better early indicator of acute kidney injury; as a result, in a study population where the risk of AKI is low, sensitive markers like cystatin C should be used more frequently to assess the effects of fluid therapy on renal function outcomes. Our results are consistent with the earlier study by John F. et al.[13] who also failed to find a significant difference in post-operative GFR between groups receiving restricted and liberal fluid therapy when estimated GFR was

calculated using the C & G formula based on serum creatinine and the CKD-EPI formula based on combination of serum creatinine and Cystatin C levels. according to the CKD-EPI formula, which is based on the combination of cystatin C and creatinine levels, both groups in our study showed a large increase in cystatin levels, a significant fall in blood potassium levels, and a significant reduction in GFR. John F. et al.[13] discovered a considerable reduction in blood urea levels in both groups, a significant reduction in creatinine levels, and a large rise in GFR in the group receiving liberal fluid therapy alone. In both groups, Cesur et al.[10] found a significant decrease in serum potassium and albumin levels and a considerable rise in serum chloride levels.There were no complications of infections, pulmonary, cardiac, gastrointestinal or renal in either of two groups and neither any post-operative mortality in two groups in the present study. Myles et al[15] reported in their study that mortality was observed in 6.4% of patients in both the groups and surgical site infection and sepsis in 16.5% and 10.6% of restrictive therapy and 13.6% and 8.7% of liberal therapy groups, thereby depicting increase of post-operative complications in restrictive group.

Conclusion:

To assign the correct use of intravenous fluids in perioperative period for better patient outcome in the present study, correlation of renal function parameters is required liberal or conventional fluid therapy seems to have an edge over restricted fluid therapy.

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