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Effect of Restrictive Intraoperative Intravenous Fluids Combined with Prophylactic Noradrenaline on Postoperative Morbidity in Open Abdominal Procedures

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Abstract

Background: Fluid regimens are variable and the choice of restrictive or liberal can have an impact on postoperative outcome especially during major procedures such as those of abdominal surgeries. The use of intraoperative noradrenaline infusion has been attributed to maintain perfusion alongside the restrictive regimen. The outcome is assessed both intra- and postoperatively using biomarkers and morbidity survey (Clavien Dindo classification).

Aim of the Study: Our goal was to evaluate the effect of restrictive hydration while infusing noradrenaline followed by postoperative assessment of complications and hospital stay as opposed to liberal hydration in open abdominal procedures.

Patients and Methods: In this randomized double blinded study, 70 patients were split into two sections (restrictive and conventional hydration) scheduled for open abdominal procedures namely radical cystectomy & hemi colectomy. They were then evaluated in the postoperative period for any morbidity or mortality.

- *Restrictive group (n=35):* A primary infusion of Ringer's solution (1ml/kg/h) till the accomplishment of tumor resection, followed by a different dose of 4ml/kg/h before postoperative transfer. The dose of the prophylactic noradrenaline infusion perioperatively was 0.08ug/kg/min.
- *Conventional group (n=35):* An initial bolus of 5 ml/kg of Ringer's solution was infused intraoperatively in the early moments of surgery during anesthesia induction. It was then followed by the usual fluid administration in the form of maintenance, deficit and any other losses.

The primary outcome we targeted was postoperative morbidity by the Clavien-Dindo classification and length of hospital stay. Secondary outcome included intra and postoperative biomarkers and hemodynamics.

Results: The restricted fluid regimen with prophylactic noradrenaline resulted in lower incidence of complications (whether medical or surgical) in contrast to liberal hydration.

Conclusion: Restricting intravenous fluid therapy plus prophylactic noradrenaline infusion is a safe and effective method of intraoperative hydration with better postoperative outcome.

Key Words: *: Restrictive hydration – Noradrenaline infusion – postoperative outcome – Conventional hydration.*

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Introduction

INTRAVENOUS fluid therapy is a vital measure in the management of the surgical patient. Perioperative administration of intravenous fluids is a responsibility of the anesthetist who must be oriented in the principles that guide the therapy. Their appropriate use can be life-saving, while inappropriate use might jeopardize the clinical outcome and even be a threat to the patient's life.

The amount of fluid infused has been shown to greatly affect the course of the postoperative follow-up, at least after some types of operations. Another important insight is that guiding fluid therapy by dynamic hemodynamic measures reduces the risk of postoperative complications. The choice of an optimal perioperative fluid strategy may be of major importance for the clinical outcome of a surgical patient. However, the characterization of the “most optimal fluid strategy” is still a matter of dispute as “restrictive,” “balanced” as well as “liberal” fluid therapies have been advocated as the most favourable. Therefore no evidence based standardized perioperative surgical procedure-specific guidelines for fluid therapy has so far been agreed upon.

It is crucial in the perioperative period to achieve and maintain an acceptable fluid balance whereby adequate tissue perfusion and oxygenation

of vital organs is guaranteed. In case fluid imbalance occurs this could result in an obvious risk of impaired postoperative recovery, increased morbidity and prolonged hospital stay. A strategy for optimization of perioperative fluid management could be to include a combination of rather fixed crystalloid administration to replace basal fluid requirements and extravascular losses, together with more individualized goal-directed colloid administration to maintain an adequate intravascular volume and thereby a maximal cardiac stroke volume and favorable tissue perfusion **[1]**.

Open abdominal surgery has been always associated with dehydration due to multiple factors such as fasting, bowel preparation and fluid shifts or third spacing **[2,3]**. Current practice of fluid replacement is based on maintenance, deficit and third space losses with doses up to 15ml/kg/h fluids **[4.5]**.

In this study, the concept of restrictive hydration combined with norepinephrine infusion will be demonstrated versus conventional hydration in open abdominal-pelvic surgeries and the outcome as regards the postoperative course was assessed.

Patients and Methods

After the patients were consented, their enrollment in this randomized double blinded study using closed envelopes was carried out into two equal groups at the Kasr Aini Hospital during the period from July 2016 till June 2017.

Group 1: Restrictive hydration plus prophylactic intravenous noradrenaline (n=35):

Shortly before initiation of surgery, noradrenaline infusion was started and maintained at a rate of 0.08ug/kg/min until the end of surgery with the preservation of mean arterial pressure in the range of 70-100mmHg. Ringer's solution was infused at a rate of 1 ml/kg/h until tumor resection was accomplished, followed by 4ml/kg/h of Ringer's solution until the end of surgery. In the incidence of hypotension, management was carried out by either bolus of crystalloid (250ml), colloids (50ml) or increasing the dose of noradrenaline.

Group 2: Liberal hydration (n=35):

A preload bolus of 5 ml/kg of balanced Ringer's solution was administrated during induction of anesthesia. Then the conventional fluid replacement was introduced according to maintenance (each hour 4ml/kg for 1st 10kg and 2ml/kg for 2nd 10kg and 1ml/kg for the next 10kg to follow), deficit for the first 3 hours (hours fasting x body weight) and 3rd space loss (estimated between 8-10ml/kg/hour). If hypotension was observed (MAP <60 mmHg) a bolus of 250ml balanced Ringer's solution was given and in case of persistent hypotension this procedure was repeated to a maximum of 10 boluses.

In both groups, blood loss of greater than 500 ml was substituted with an equal amount of balanced Ringer's solution; transfusion of packed erythrocytes units if hemoglobin values were less than 8g/dl (<10g/dl in patients with history of coronary artery disease). Colloid solution was only infused as a rescue medication if a MAP less than 60mmHg persisted after the above mentioned correction with balanced Ringer's solution.

Preoperative assessment and patient counseling:

All patients underwent systematic preoperative assessment 24 hours prior to the scheduled date of surgery. This included history, physical examination and review of routine investigations:

- Complete blood picture.
- Liver & renal function test.
- Random blood sugar.
- Coagulation profile.
- Serum electrolytes.
- 12-leads ECG.
- Cardiac biomarker Troponin I.

Patients fasted 6 hours before surgery and drank clear drinks till two hours before.

Anesthetic management:

All patients were premedicated with midazolam (0.05mg/kg mg) 30min before induction of anesthesia. Standard monitoring included continuous electrocardiographic data, heart rate, pulse oximetry, invasive mean arterial pressure (MAP) and central venous pressure with a venous catheter inserted in the jugular vein. A nasopharyngeal temperature probe was inserted. An epidural catheter was sited at the L1/2 level before induction of general anesthesia: An 18-gauge epidural needle inserted by a midline approach and the epidural space identified with the loss-of-resistance technique. After a test dose of 1.5ml lidocaine 2% with 0.005 mg/ml epinephrine to rule out subarachnoidal or intravascular placement, a 0.25% bupivacaine infusion at a rate of 8ml/h was administrated. Anesthesia induction included propofol (2mg/kg), fentanyl (2gg/kg), atracurium (0.5mg/kg) and maintenance with isoflurane at minimum alveolar concentration of 1. Also mechanically controlled ventilation with an inspired oxygen fraction of 100% to maintain

$P_{arterial}CO_2$ between 35 and 40 mmHg, plus a positive end-expiratory pressure of 5cmH_2O and the lowest allowable tidal volume to keep the PCO_2 within the desired range. Normothermia was maintained with a convective air warming system.

Intra- and postoperative biomarkers:

Two arterial blood gases were analysed for pH, potassium, sodium and serum lactate, one after induction and the other at the end of surgery. Hemoglobin, hematocrit, C-reactive protein, albumin, and creatinine levels were assessed preoperatively, on PODs (postoperative days) 1, 2, and 5. The cardiac biomarkers high-sensitive troponin I, were assessed preoperatively, on PODs 1 and 2. At hospital discharge, hemoglobin, hematocrit, creatinine were assessed.

Postoperative patient management:

After surgery patients were admitted to the intermediate care unit. IV paracetamol was given postoperatively and the epidural analgesia sustained during the postoperative phase with a mixture composed of bupivacaine 0.1%, fentanyl 2 µg/ml, and epinephrine 2µg/ml. The initial infusion rate was 8ml/h, with a maximum infusion rate till 12ml/h, and with additional bolus volumes of 5ml. The epidural catheter was removed on POD 3.

Postoperative hydration was identical in both groups and consisted primarily of 1,000ml of balanced Ringer's solution and 1000ml of glucose 5% per 24 h until resumption of normal food intake. If the MAP drops below 60mmHg, first, a bolus of 500ml of balanced Ringer's solution was administrated, second, by persistent MAP less than 60mm Hg, norepinephrine infused up to a rate of 0.1ug/kg/min. Packed erythrocytes units were transfused according to the American Society of Anesthesiologists guidelines, [6] and fresh frozen plasma transfusion given if the prothrombin time was greater than 1.5 times the normal value.

Postoperative patients were allowed to drink clear fluids immediately and a peroral liquid diet started on POD 1-2 as well as active mobilization. To enhance recovery of bowel function, the use of chewing gum was encouraged. Low-molecular-weight heparin were started on the evening before surgery (12 hours before epidural) and maintained throughout hospitalization.

Inclusion criteria:

- Patients with American Society of Anesthesiologists (ASA) physical status I or II.
- Age range from 18-80 years.

Exclusion criteria:

- Coagulopathies.
- Hepatic dysfunction (prothrombin ratio <50%).
- Renal dysfunction.
- Congestive heart failure (New York Heart Association scores ›_3).
- Contraindications for epidural analgesia (e.g. patient refusal, local infection or coagulopathy).
- Peripheral vascular disease.

Statistical analysis:

Data were coded and entered using the statistical package SPSS version 24 and summarized using mean and standard deviation for quantitative variables and frequencies (number of cases) and relative frequencies (percentages) for categorical variables. Comparisons between groups were done using unpaired *t*-test when comparing 2 groups. For comparing categorical data, Chi square (χ^2) test was performed. Exact test was used instead when the expected frequency is less than 5. *p*-values less than 0.05 were considered as statistically significant [7,8].

Outcome parameters:

- *Primary:* Postoperative morbidity and complications by the Clavien-Dindo classification (see Table 1) and length of hospital stay.
- *Secondary:* Intra and postoperative biomarkers and hemodynamics.

Results

Seventy patients fulfilled the study inclusion criteria. They were randomized and allocated into two groups, restrictive hydration and liberal hydration groups with 35 patients in each. Regarding their demographic data they were between ages 40-80 with ASA status I and II and both sexes (male and female) involved. Surgeries performed in each of the 2 groups were radical cystectomy and hemicolectomy both performed for tumor resection. In the restrictive hydration group, 20 patients underwent radical cystectomy and 15 hemicolectomy while the liberal group included 18 radical cystectomy patients and 17 hemicolectomy.

Postoperative morbidity and mortality:

The incidence of complications during hospital stay was assessed by the Clavien-Dindo classification in both groups starting from immediate postoperative interval until discharge (Table 2). Statistical significance is noted by *p*-value <0.005.

The average length of stay in the intensive care unit (ICU) was between 1-4 days with only 3 patients that required mechanical ventilation. Hospital stay was similar in both groups between 5-14 days. Patients that experienced burst abdomen were transferred to the surgical theatre for repair. All patients in both groups were noted to have hypoalbuminemia both pre and postoperative managed by albumin infusions postoperative till levels normalized.

Intra and postoperative biomarkers:

Intraoperative values showed only a statistical significance for serum lactate level (1.30 ±0.22 for restrictive group vs. 1.84±0.23 for liberal group) with p-value <0.001. (see Table 3). Hemoglobin (Hb), hematocrit (Hct), Albumin, creatinine, C reactive protein (CRP) and troponin levels were assessed in the immediate postoperative period (Day 0 or D0) and on day 1, 2, 5 (D1, 2, 5 respectively) and at discharge except for troponin which was assessed up to day 2 only. As regards Hb and Hct levels there was no statistical significance. (Tables 4,5).

For albumin levels, there was a statistically significant difference between the two groups starting from day 1 (D 1) until the day of discharge (Table 6). Measurements of CRP postoperatively revealed a statistically significant difference among the two study groups at D1, D2 and discharge where it was higher in the restrictive group at D1 and 2. At D5 no statistically significant difference was found. But on discharge the liberal group showed higher CRP levels (Table 7).

Regarding creatinine measurements, there was no significant difference among the two groups at D0. However, at D1,2,5 and discharge there was a statistically significant difference between groups where it was higher in liberal group compared to restrictive (Table 8).

Regarding troponin levels, there was no significant difference among the groups at D1 and 2 postoperative (Table 9). However, the levels were elevated at D0 and 1 with higher percentage in the liberal group (11.4%) vs. restrictive (8.6%) at D0 and 5.7% vs. 2.9% at D1 for both groups respectively. From D2 levels declined towards normal.

Table (1): Clavien-dindo classification of surgical complications.

Full Scale		Contracted Form	
Grades	Definition	Grades	Definition
Grade I:	• Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical,endoscopic and radiological interventions. • Allowed therapeutic regimens are: Drugs as antiemetics,antipyretics, analgesics, diuretics and electrolytes and physiotherapy. This grade also includes wound infections opened at the bedside.	Grade I:	Same as for Full Scale
Grade II:	• Requiring pharmacological treatment with drugs other than such allowed for grade I complications. Blood transfusions and total parenteral nutrition are also included.	Grade II:	Same as for Full Scale
Grade III:	• Requiring surgical, endoscopic or radiological intervention.	Grade III:	Grades IIIa & IIIb
Grade III-a:	• Intervention not under general anesthesia.		
Grade III-b:	• Intervention under general anesthesia.		
Grade IV:	• Life-threatening complication (including CNS complications)‡ requiring IC/ICU-management.	Grade IV:	Grades IVa & IVb
Grade IV-a:	• Single organ dysfunction (including dialysis).		
Grade IV-b:	• Multi organ dysfunction.		
Grade V:	• Death of a patient.	Grade V:	Same as for Full Scale
Suffix 'd':	• If the patient suffers from a complication at the time of discharge, the suffix “d” (for 'disability') is added to the respective grade of complication. This label indicates the need for a follow-up to fully evaluate the complication.		

‡Brain hemorrhage, ischemic stroke, subarrachnoidal bleeding,but excluding transient ischemic attacks (TIA).
IC: Intermediate care. ICU: Intensive care unit.

Table (2): Postoperative incidence of complications during hospitalization.

	Restrictive group		Liberal group		*p*-value
	Count	%	Count	%	
Hypoalbuminemia:					
y	35	100.0	35	100.0	–
Anemia:					
y	9	25.7	7	20.0	0.569
n	26	74.3	28	80.0	
Fever:					
y	3	8.6	6	17.1	0.477
n	32	91.4	29	82.9	
Postoperative blood transfusion:					
y	5	14.3	4	11.4	1
n	30	85.7	31	88.6	
Nausea & vomiting:					
y	4	11.4	5	14.3	1
n	31	88.6	30	85.7	
Wound dehiscence:					
y	6	17.1	6	17.1	1
n	29	82.9	29	82.9	
Wound discharge:					
y	10	28.6	7	20.0	0.403
n	25	71.4	28	80.0	
Burst abdomen:					
y	3	8.6	6	17.1	0.477
n	32	91.4	29	82.9	
Urine leakage (only for radical cystectomy):					
y	3	15.0	4	22.2	0.687
n	17	85.0	14	77.8	
Metabolic acidosis					
y	0	.0	4	11.4	0.039
n	35	100.0	31	88.6	
Pneumonia:					
y	0	.0	1	2.9	1
n	35	100.0	34	97.1	
Disturbed conscious level:					
y	0	.0	3	8.6	0.239
n	35	100.0	32	91.4	
Atrial fibrillation:					
y	0	.0	1	2.9	1
n	35	100.0	34	97.1	

Y=yes n=no.

Table (3): Hemodynamics, electrolytes & lactate level of both groups intraoperatively.

	Group				*p*-value
	Restrictive group		Liberal group		
	Mean	Standard Deviation	Mean	Standard Deviation	
Intraoperative MAP	87.00	7.88	86.31	6.77	0.697
Intraoperative HR	86.51	8.24	88.74	9.20	0.290
Intraoperative Na^+	135.66	2.07	135.97	2.04	0.524
Intraoperative K^+	3.88	.30	3.79	.23	0.168
Intraoperative lactate	1.30	.22	1.84	.23	<0.001*

* Indicates statistical significance.

Table (4): Hemoglobin levels in both groups from D0 to discharge.

	Group				*p*-value
	Restrictive group		Liberal group		
	Mean	Standard Deviation	Mean	Standard Deviation	
Hemoglobin levels (g/dl) postoperatively D0	9.88	.81	9.74	.65	0.410
Hemoglobin levels (g/dl) postoperatively D1	10.23	.67	10.29	.68	0.711
Hemoglobin levels (g/dl) postoperatively D2	10.53	.59	10.72	.75	0.238
Hemoglobin levels (g/dl) postoperatively D5	10.98	.56	11.24	.69	0.090
Hemoglobin levels (g/dl) postoperatively Discharge	11.55	.55	11.75	.76	0.198

Table (5): Hematocrit levels in both groups from D0 to discharge.

	Group				*p*-value
	Restrictive group		Liberal group		
	Mean	Standard Deviation	Mean	Standard Deviation	
Hematocrit levels in % postoperatively D0	29.46	2.55	28.97	2.12	0.389
Hematocrit levels in % postoperatively D1	30.54	1.92	30.63	2.14	0.860
Hematocrit levels in % postoperatively D2	31.40	1.80	31.83	2.28	0.386
Hematocrit levels in % postoperatively D5	32.86	1.77	33.51	2.15	0.167
Hematocrit levels in % postoperatively Discharge	34.43	1.67	34.91	2.23	0.305

Table (6): Albumin levels in both groups from D0 to discharge.

	Group				*p*-value
	Restrictive group		Liberal group		
	Mean	Standard Deviation	Mean	Standard Deviation	
Albumin level (g/dl) postoperatively D0	2.45	.32	2.51	.28	0.364
Albumin level (g/dl) postoperatively D1	2.73	.30	2.89	.27	0.019*
Albumin level (g/dl) postoperatively D2	3.07	.27	3.27	.29	0.004*
Albumin level (g/dl) postoperatively D5	3.50	.29	3.83	.32	<0.001 *
Albumin level (g/dl) postoperatively Discharge	3.87	.23	4.17	.32	<0.001 *

* Indicates statistical significance.

Table (7): CRP levels in both groups from D0 till discharge.

	Group				*p*-value
	Restrictive group		Liberal group		
	Mean	Standard Deviation	Mean	Standard Deviation	
CRP levels (mg/l) postoperatively D0	73.54	20.18	76.86	17.34	0.464
CRP levels (mg/l) postoperatively D1	118.17	20.11	107.40	23.92	0.045*
CRP levels (mg/l) postoperatively D2	114.00	23.14	93.26	27.55	0.001 *
CRP levels (mg/l) postoperatively D5	42.80	15.76	46.54	17.58	0.352
CRP levels (mg/l) postoperatively Discharge	12.83	4.85	16.23	5.05	0.005*

* Indicates statistical significance.

Table (8): Creatinine levels in both groups from D0 to discharge.

	Group				*p*-value
	Restrictive group		Liberal group		
	Mean	Standard Deviation	Mean	Standard Deviation	
Creatinine levels (mg/dl) postoperative D0	1.63	.32	1.75	.28	0.108
Creatinine levels (mg/dl) postoperative D1	1.45	.27	1.62	.27	0.015*
Creatinine levels (mg/dl) postoperative D2	1.31	.28	1.45	.29	0.041*
Creatinine levels (mg/dl) postoperative D5	1.11	.21	1.24	.24	0.017*
Creatinine levels (mg/dl) postoperative Discharge	.93	.17	1.02	.20	0.044*

'*' Indicates statistical significance.

Table (9): Troponin levels from D0 to D2 in both groups.

	Group				*p*-value
	Restrictive group		Liberal group		
	Count	%	Count	%	
Troponin levels postoperative Day 0:					
Positive	3	8.6	4	11.4	1
Negative	32	91.4	31	88.6	
Troponin levels postoperative Day 1:					
Positive	1	2.9	2	5.7	1
Negative	34	97.1	33	94.3	
Troponin levels postoperative Day 2:					
Negative	35	100.0	35	100.0	–

Discussion

The concept of intraoperative restrictive fluid therapy has been widely utilized over the past years for its association with less postoperative complications and as part of the ERAS (enhanced recovery after surgery) program for major abdominal surgeries that are associated with many risks, and the personal, social and economic consequences of postoperative complications is substantial. Strategies to mitigate these risks, therefore, are keenly sought, and recently attention has turned to the influence that intravenous fluid administration might have on outcomes. In this study, the question whether restrictive hydration combined with norepinephrine infusion improves postoperative outcome as opposed to liberal (conventional) hydration, was investigated in a number of patients undergoing open abdominal surgeries.

Historically perioperative intravenous fluid administration has been liberal. Since the 1950s, when it was first claimed that fluids are redistributed to a theoretical 'third space' perioperatively, **[3]** intravenous fluid administration has included replacement of such third-space losses with crystalloid. In addition liberal fluid administration causes edema, with increased pulmonary morbidity, **[9]** impaired coagulation, 10 bacterial translocation and sepsis **[1]** and poor wound healing **[12]**.

The results of this study agree with Wutherich PY et al., **[13]** who compared restrictive hydration combined with norepinephrine infusion and liberal hydration in 166 radical cystectomy patients. In-hospital complications occurred in 43 of 83 patients (52%) in the restrictive group and in 61 of 83 (73%) in the control (liberal hydration) group. Also the median hospitalization time was 15 days in the restrictive group and 17 days in the control group.

In another study conducted by Fiona Burkhard et al., **[14]**, renal outcome was assessed postoperatively in a group of radical cystectomy patients using the same methods and groups mentioned above. They concluded that postoperative renal function evolution was similar in patients receiving restrictive hydration with norepinephrine administration when compared to liberal hydration intraoperatively, suggesting that there is no influence of fluid management and administration of vasopressors on mid-term renal function.

A common argument against restrictive hydration is the fear of increased infectious complications attributable to hypovolemia and the ensuing tissue hypoperfusion. However, in the present study this wasn't the case where the incidence of such complications was less in restrictive hydration than that of liberal hydration. On the contrary, Futier E. et al., [15] compared 6mL/kg/h of crystalloid (a restrictive fluid strategy) vs. 12mL/kg/h of crystalloid (a more conservative fluid strategy) in 70 patients undergoing major abdominal surgery. Overall incidence of complications, including postoperative anastomotic leak and sepsis, was higher in the restrictive group than in the conservative group (all $p<.05$). The number of patients with hypovolemia increased significantly in the restrictive group compared with the conservative group ($p<.001$). The perioperative mean $Scvo_2$ (central venous oxygen saturation) ($p=.02$) and mean minimum $Scvo_2$ ($p=.04$) were significantly lower in the restrictive group than in the conservative group indicating tissue hypoperfusion.

The use of norepinephrine infusion was a concern owing to its vasoconstrictive effect. The study results however proved that the preemptive norepinephrine infusion at an initial rate of 2 gg/kg/h has no identifiable negative consequences. On the contrary, it counteracts the decreased sympathetic tone and vasodilatation induced by epidural analgesia, anesthetics, and analgesics and may be more physiological at compensating for derangements of the vascular system than the liberal use of IV fluids. This is also substantiated by the overall lower complication rate in this group. Wutherich PY et al., devised the same method and reached the same conclusion [13].

In a study by K. Holte et al., [16], it was surprising that the trend to more anastomotic leakages (3 in the restrictive vs. none in the liberal fluid group) may question restrictive fluid administration strategies in surgery involving intestinal anastomosis and therefore call for further studies. Healing of colonic anastomoses has previously been found to be influenced by intestinal tissue oxygen tension, which may decrease with administration of large amounts of crystalloid. However, dehydration, as shown in experimental studies, has adverse effects on anastomotic healing. The trend towards lower systolic pressure in the PACU with restrictive fluid in this study may indicate a lower peripheral perfusion and thus propensity for organ failure. On the contrary to the present study here, it was found that the incidence of anastomotic leakage was higher in the liberal hydration group (maybe caused by tissue edema) up to that a number of patients were readmitted several days after discharge and re-operated upon.

Regarding albumin levels, Wutherich PY et al., [13] found a slight decrease between first and fifth days postoperative (from 3.2g/dl to 2.7g/dl) specifically in radical cystectomy patients, whereas in the current study, hypoalbuminemia was present pre and postoperatively then started to rise day by day postoperatively. The present hypoalbuminemia, in both restrictive and liberal hydration groups, regardless of the surgery, was attributed to the use of bowel preparation and keeping patients NPO (nothing per oral) for a few days before and after surgery.

Another noticeable finding is that of metabolic acidosis found exclusively in the liberal group (11.4%, p .039). This could be attributed to the use of large volumes of normal saline 0.9% (>4 liters) causing hyperchloremic metabolic acidosis. Park CM et al. [17] studied 172 patients admitted to a surgical intensive care unit (ICU) following major abdominal surgery. The comparison between the types of fluid (normal saline and lactated Ringers), revealed that the saline group had a significantly lower SBE (standard base excess), strong ion difference and higher corrected chloride. They concluded that post-operative metabolic acidosis following major abdominal surgery was closely related to both hyperchloremic acidosis associated with large saline infusion and lactic acidosis caused by lactataemia.

Inflammatory marker levels, namely C-reactive protein (CRP), showed elevation in the early postoperative period up to day 2 and declined until normal values at discharge. The restrictive group showed a slightly higher value than the liberal one. Persistently high CRP levels after POD 4, especially when >100mg/L, suggest the presence of a postoperative infection [18].

Conclusion:

The present study concluded that restrictive fluid regimen has a better postoperative outcome in terms of complication rate and lower mortality, in addition to the use of norepinephrine infusion that helps to maintain hemodynamics intraoperatively along with fluid boluses. Despite the fact that the length of hospital stay was not significantly different between both liberal and restrictive groups, the latter had less morbidity without jeopardizing any body function and less postoperative intervention.

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دورة الترطيب التقييدى جنباً إلى جنب مع ضخ بافرازية بعقار نورابينفرين بالمقارنة مع الترطيب الليبرالى فى الحد من المضاعفات بعد العملية الجراحية والوقت فى المستشفى فى إجراءات مفتوحة فى البطن

العلاج السائل عن طريق الوريد هو حجر الزاوية فى علاج المريض الجراحى. إدارة الجراحة عن طريق الوريد مع السوائل هى مسؤولية التخدير ولكن العديد من الآخرين، بما فى ذلك الجراح، يجب أن تكون موجهة فى المبادئ التى توجه العلاج.

أختيار أستراتيجية مثالية للسوائل المحيطة بالجراحة لديها أهمية كبيرة للنتيجة السريرية المريض الجراحى. إن (أختيار أستراتيجية السوائل الأكثر مثالية) مسألة نزاع كما دعا (التقييد)، (متوازنة) ، وكذ لك (ليبرالية)، العلاجات السوائل بأعتبارها الأكثر ملاءمة. فمن الضرورى فى الفترة المحيطة بالجراحة لتحقيق والحفاظ على توازن السوائل مقبولة حيث يتم ضمان نضج الأنسجة الكافية والأكسجين من الأعضاء الحيوية. فى حالة عدم توازن السوائل يحدث هذا يمكن أن يؤدى إلى خطر واضح من ضعف الأنعاش بعد العملية الجراحية، وزيادة معدلات الأعتلال والإقامة لفترة طويلة فى المستشفى. ويمكن أن تكون أستراتيجية لتحسين إدارة السوائل المحيطة بالجراحة لتشمل مجموعة من المحاليا البلورية الثابتة لتحل محل متطلبات السوائل القاعدية والخسائر خارج الأوعية، جنباً الى جنب مع إعطاء محاليل غروانية للحفاظ على حجم الأوعية الدموية الكافية وبالتالى الحد الأقصى لحجم ضخ الدم من القلب ونضج الأنسجة مواتية.

فى هذه الدراسة وسؤال ما إذا كان الترطيب التقييدى جنباً إلى جنب مع ضخ بأفراز عقار النورابينفرين يحسن نتائج ما بعد الجراحة بدلا من ليبرالية (التقليدية) الترطيب ، قد تم التحقيق منه فى عدد من المرضى الذين يخضعون لعملية جراحية فى البطن المفتوحة. تم تقييم مجموعتين من ٣٥ مريضاً لكل منهما (واحدة لترطيب ليبرالى والأخرى للترطيب المقيد جنباً الى جنب مع ضخ بأفراز عقار النورابينفرين أثناء الجراحة) قاموا بعمليات جراحية كبرى فى البطن مع توحيد تقنية التخدير، وبعد العمل الجراحى. تم التقييم من قبل بعض الدرجات والأستبيانات التى تشمل المرضى والوفيات وطول البقاء فى العناية المركزة أو المستشفى.

كشفت النتائج عن إنخفاض عام فى المرضى والوفيات بعد العملية الجراحية الترطيب المقيد رزاء الترطيب اليبرالى . كان طول البقاء فى وحدة العناية المركزة و فى المستشفى مماثل فى كلتا المجموعتين مع ١-٤ أيام فى الاولى، ٥- ١٤ يوماً فى هذا الأخير. لوحظ الفرق الإحصائى الكبير فى مستوى اللبنات أثناء العملية والمؤشرات الحيوية فى مستوى الكرياتينين ، بروتين سى التفاعلى والألبومين بعد العمليةالجراحية كلا النظامين آمنين وكان الحد الأدنى من الآثار السلبية مع النظام التقليدى تظهر نتائج أفضل بعد العملية الجراحية.