Section: General Surgery

Original Research Article

EVALUATION OF FLUID THERAPY OF NEAR MAXIMAL STROKE VOLUME DURING GASTROINTESTINAL SURGERY WITH THAT OF STANDARD PRACTICE

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Abstract
Background: The following study has discussed the significance of "Fluid Therapy" during "Gastrointestinal Surgery" for patients. Through the following discussion, it has been explored that around 50% of people in this world are required to have gastrointestinal surgery and as an example, 4500 patients in Denmark are required to have gastrointestinal surgery every year. Targeted fluid therapy is an effective procedure for the treatment of gastrointestinal surgery. The aims and objective are to evaluate the efficacy of targeted fluid therapy of near-maximal stroke volume as compared to the standard practice of fluid therapy in patients undergoing orthopedic surgeries. **Materials and Methods:** To conduct this research (This Study was research during the period of one year), the researcher used a retrospective study that occurred with 70 patients who were 40 to 70 years old. This experiment was approved by an Institutional Research Ethics Committee, and all participants provided written approval before enrollment. Patients were randomly appointed to either the control group .70 participants were randomly appointed to either the control group or the Targeted Fluid Therapy (TFT) group, and the anesthetist responsible for intraoperative surveillance was aware of the group assignment. **Result:** Data analysis was conducted using SPSS 19.0, and commonly checked using the Kolmogorov-Smirnov test. Furthermore, these continuous data were introduced as means ± SD and analyzed utilizing t-tests, while non-normally allocated data were demonstrated as medians (IQR) and analyzed employing the Mann-Whitney U test. The researcher conducted these findings between two groups that were well-matched and any differences observed in the analysis can be attributed to the intervention (TFT) rather than baseline differences. **Conclusion:** The study has concluded that targeted fluid therapy has been more beneficial than standard therapy for those patients who received orthopedic surgery.

INTRODUCTION

Following an urgent large gastrointestinal operation, death, and complications are common.[1] The disease is concerning, through complication rates described as approximately greater than 50% of patients, and mortality rates of 15% to 25%.[2-5] A few hundred thousand people worldwide, including about 4500 patients in Denmark each year, require urgent gastrointestinal surgery.[6,7] An essential component of perioperative care is intravenous fluid delivery. The difficult part is figuring out just how many liquids should be administered. The fluid volume administered during planned gastrointestinal surgery has significantly impacted the recovery process.[8–13] Yet, there aren't many studies examining perioperative fluid treatment for individuals having urgent surgery.

Fluid treatment is a common procedure throughout surgical treatment, although anesthesiologists disagree on the category, quantity, and scheduling of fluids given to patients undergoing the most important abdominal surgical treatment. Surgical morbidity and mortality have been linked in large part to the perioperative fluid balance. Throughout the past several decades, fluid remedy methods were established as well as put into use in clinical settings. According to the evidence, forceful or liberal intraoperative fluid resuscitation throughout open abdominal surgeries is hazardous, although a restrictive fluid strategy has superior results, together with fewer postoperative problems besides a faster discharge time.[14-16] A limiting hydration regimen, however, has a number of drawbacks.[17] Fluid delivery that is excessively restricted or insufficient might increase the risk of complications, time spent in the hospital, as well as mortality by causing inadequate intravascular volume, tissue hypo-perfusion, cellular oxygenation impairment, as well as probable organ failure.[18]

Administration of intravenous fluids is essential for maintaining circulation and ensuring that oxygen reaches key organs. Negotiated fluid intake, nausea, vomiting, sepsis, as well as additional pathological fluid losses are frequent complications for patients with diseases that necessitate immediate surgical intervention, underscoring the critical prerequisite aimed at intravenous fluid treatment towards preventing circulatory shock and demise. Hence, it is standard practice to administer copious amounts of intravenous fluid before, during, and after surgery at levels significantly above the losses.[19,20] Nevertheless, there is no need to think that the detrimental effects of fluid excess observed in the investigations of patients receiving elective surgery don't apply to patients needing crucial surgical treatment. Interstitial edema promotes anastomosis leakage, amplifies tissue inflammation, and impairs wound healing.[21,22] Acute respiratory distress syndrome, pulmonary edema, and cardiac arrhythmia may also ensue.

Based on routine surveillance, it is challenging to quantify or even estimate the circulatory volume. Heart rate (HR) and diuresis are impacted by acute inflammation and stress response. When there is severe hypovolaemia, arterial blood pressure and central venous pressure (CVP) react, although they cannot accurately predict normovolaemic or fluid overload, i.e., when to discontinue intravenous fluid infusion. Consequently, clinical fluid therapy cannot be directed by common physiological markers. A conventional in-out fluid balance (utilized in trials of optional surgical treatment towards minimizing fluid overload) is not helpful aimed at patients of crucial operating procedures since they are frequently hypovolemic at admission.

Goal-directed fluid management, sometimes referred to as stroke volume (SV), is utilized for target fluid administration in response to the need for a more dynamic variable (TFT). With the help of bolus infusions of a colloid, TFT can achieve a submaximal SV while avoiding both hypovolemia and excessive fluid delivery. According to studies,[23–26] employing intraoperative TFT during scheduled gastrointestinal surgery can shorten hospital stays and minimize complications. According to reported results, zero-balance TFT may have the capacity to identifytogether fluid overload as well as hypovolaemia and direct fluid therapy towards normovolaemia, hence lowering morbidity and mortality after urgent surgery.

MATERIALS AND METHODS

Research Design

This retrospective study was conducted on 70 patients who were 40 to 70 years old. This is a randomized controlled trial that aims to compare standard care management with goal-directed fluid therapy in patients undergoing major orthopedic surgery. The trial was approved by an Institutional Research Ethics Committee, and all patients provided written informed consent before enrollment. Eligible patients were those scheduled for elective major orthopedic surgery under general anesthesia, with an anticipated blood loss >800 ml. 70 patients were randomly assigned to either the control group or the Targeted Fluid Therapy (TFT) group, and the anesthetist responsible for intraoperative management was aware of the group assignment. The trial aims to determine if Targeted Fluid Therapy improves outcomes in these patients compared to standard care management.

Inclusion and Exclusion Criteria

Patients who meet the following criteria are eligible for inclusion:

- Scheduled for elective major orthopedic surgery (total hip arthroplasty, spinal fusion surgery, femoral fracture surgery, or sacral tumor surgery)
- Under general anesthesia
- Anticipated blood loss >800 ml

Patients who meet any of the following criteria are excluded:

- Age under 40 years old and above 70 years old.
- BMI >40 or <15
- Coagulopathy (blood clotting disorder)
- Significant arrhythmia or cardiopulmonary dysfunction
- Significant renal or liver diseases

Statistical Analysis

The study aimed to compare the time to pass the first flatus in two groups using statistical power analysis. The required sample size was determined to be 40-70 age patients per group, with a total of 70 patients studied. Data analysis was performed using SPSS 19.0, and normality was checked using the Kolmogorov-Smirnov test. Continuous data were presented as means ± SD and analyzed using t-tests, while non-normally distributed data were presented as medians (IQR) and analyzed using the Mann-Whitney U test. Categorical data were presented as numbers (%) and analyzed using Fisher's exact test. Statistical significance was set at $p < 0.05$ for all tests.

RESULTS

[Table 1] displays demographic and surgical data for two groups of patients (TFT and Control) who underwent different types of surgeries. The groups were similar in terms of gender distribution, age, weight, height, BMI, position during surgery, ASA classification, and comorbidities. The duration of surgery and intraoperative BIS values were also similar in both groups. These findings suggest that the two groups were well-matched and that any differences observed in the study can be attributed to the intervention (TFT) rather than baseline differences.

[Table 2] presents the hemodynamic data, laboratory parameters, and fluid management of patients undergoing surgery with either Targeted Fluid Therapy (TFT) or standard care. The TFT group had lower mean arterial pressure (MAP) and central venous pressure (CVP) at the end of surgery while having a lower stroke volume variation (SVV) and fewer hypotensive events. Laboratory parameters such as PgCO2, pHa, and pHi were also different between the two groups. The TFT group received more colloids and had a higher total volume infused compared to the control group.

[Table 3] presents the postoperative complications and fluid management data for patients in a study comparing Targeted Fluid Therapy (TFT) to a control group. There were no significant differences in most complications, fluid management, and mortality between the two groups. The TFT group had a shorter time to flatus compared to the control group.

Table 1: Demographic patient data and surgical characteristics

	TFT	Control	p-value
Gender (male/female), n	17/23	18/22	0.822
Age, years	55±13	53±10	0.505
Weight, kg	59±10	62±11	0.216
Height, cm	162±8	164±9	0.329
BMI	22.66±3.22	23.25±3.24	0.421
Position (supine/prone), n	25/15	22/18	0.496
ASA (I/II/III), n	17/22/1	17/21/2	0.837
Surgery			
Hip	18(52.5)	17 (50.0)	0.823
Spine	14 (40.0)	15(45.0)	0.651
Femur	2(5.0)	2(2.5)	1.000
Sacrum	1(2.5)	1(2.5)	1.000
Comorbidity			
Hypertension	11	15 (37.5)	0.340
Diabetes mellitus	2	7 (17.5)	0.157
Anemia	5 (12.5)	2 (5.0)	0.432
COPD	2 (5.0)	1 (2.5)	1.000
Multiple trauma	3 (7.5)	2 (5.0	1.000
Tuberculosis	2 (5.0)	0 (0)	0.494
Coronary artery disease	0	1 (2.5	1.000
Heart block	2	1 (2.5	1.000
Cerebral infarction	1	2 (5.0)	1.000
Duration of surgery, min	175±100	162±80	0.520
Intraoperative BIS	52±2	53±2	0.298

Table 2: Intraoperative hemodynamic data, laboratory parameters, and fluid management

	TFT		Control	
	Baseline	**End of surgery**	**Baseline**	**End of surgery**
Hemodynamic data				
Heart rate, bpm	68±11	68±13a	73±13	75±13
MAP, mm Hg	88±9	79±10b	91±10	81±12b
CVP, mm Hg	8±3	10±3b	8±3	10±3b
SVV, %	9±2	7±1b	NA	NA
Cardiac output, l/min	4.41±1.07	4.79±1.24	NA	NA
Hypotensive events	0 (0–1)a		1 (0–2)	
Laboratory parameters				
PgCO2, mm Hg	29.29±5.57	42.90±10.01a, b	30.81±5.63	48.96±11.34b
PaCO2, mm Hg	39.10±6.83	42.11±9.07b	40.63±6.11	44.26±6.75b
Pg–aCO2, mm Hg	–9.80±9.44	0.78±14.48b	–9.82±6.76	4.52±11.48b
pHa	7.42±0.04	7.36±0.06a, b	7.42±0.05	7.34±0.05b
pHi	7.55±0.10	7.37±0.11a, b	7.54±0.08	7.30±0.11b
Lactate, mmol/l	1.54±0.32	2.12±0.89b	1.61±0.57	2.35±1.02b
Hemoglobin, g/l	12.03±1.81	10.52±1.54b	11.94±1.69	10.28±1.61b
Hematocrit				0.32±0.04b
Fluid management				
Blood loss, ml	800 (600–1,000)		800 (525–1,200)	
Crystalloids infused, ml	1,000 (712–1,000)		1,000 (500–1,000)	
Colloids infused, ml	500 (312–1,000)a		1,000 (500–1,000)	
PRBC-infused, ml	600 (400–600)		600 (40	
FFP-infused FFP infused, ml	0 (0–200)		0 (0–200)	
Total volume infused, ml	1,850 (1,525–2,537)a		2,225 (1,850–2,900)	
Urinary output, ml	300 (200–400)		300 (200–475)	
Urinary output, ml/kg/h	1.98 (1.29–2.63)		2.20 (1.53–3.25)	

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Table 3: Postoperative complications and fluid management

	TFT	Control	p-value
Cardiovascular complications			
Hypotension	3 (7.5)	2 (5.0)	0.432
Arrhythmias	1 (2.5)	0 (0)	1.000
Heart failure	0 (0)	0 (0)	1.000
Respiratory complications			
Ventilator support	2 (5.0)	2 (5.0)	1.000
ALI/ARDS	1 (2.5)	0 (0)	1.000
Abdominal complications			
Flatus time, h	10±5	14±11	0.042a
Gastrointestinal hemorrhage	0 (0)	0 (0)	1.000
Hepatic dysfunction	5 (12.5)	6 (15.0)	0.745
Hepatic failure	1 (2.5)	0 (0)	1.000
Renal complications			
Urine output 0–24 h, ml	1,625 (1,175–2,412)	2,000 (1,150–2,700)	0.263
Urine output 24–48 h, ml	2,500 (1,800–3,100)	2,200 (1,700–3,525)	0.672
Renal dysfunction	1 (2.5)	3 (7.5)	0.615
Renal failure	1 (2.5)	0 (0)	1.000
Central nervous complications			
POCD	1 (2.5)	1 (2.5)	1.000
Coma	1 (2.5)	0 (0)	1.000
Infection-related complications			
Pneumonia	4 (10.0)	3 (7.5)	1.000
Wound infection	0 (0)	1 (2.5)	1.000
Wound dehiscence	0 (0)	0 (0)	1.000
Deep vein thrombosis	0 (0)	1 (2.5)	1.000
Nausea	5 (12.5)	8 (20.0)	0.363
Vomit	2 (5.0)	5 (12.5)	0.432
PCA requests	0 (0–2)	0 (0–2)	0.719
Fluid management, drainage			
Fluid infused 0–24 h, ml	2,189±659	2,109±709	0.606
Fluid infused 24–48 h, ml	1,766±965	1,806±944	0.852
Blood transfusion, ml	0 (0–200)	0 (0–200)	0.625
Drainage volume 0–24 h, ml	132 (100–263)	107 (38–187)	0.062
Drainage volume 24–48 h, ml	60 (25–120)	47 (16–135)	0.397
Drainage removal time, days	2±0	2±0	0.196
Postoperative stay, days	12±3	11±7	0.802
Mortality	1 (2.5)	0 (0)	1.000”

DISCUSSION

Voldboy et al., (2018) studied and reported randomized trials. An essential component of perioperative care for gastrointestinal surgery is intravenous fluid therapy. Hypovolemia, poor organ perfusion, and circulatory shock can result from not getting enough fluid. Increased postoperative difficulties, worsened pulmonary and cardiac function, and slowed wound healing are all effects of excessive fluid delivery. Studies on urgent gastrointestinal surgery are scarce; although intraoperative customized goal-directed fluid treatment (TFT), as well as zero-balance treatment (weight adjusted), has been demonstrated to minimize postoperative difficulties in an optional surgical procedure. Zero-balance TFT may be able to distinguish between hypovolemia and excess fluid and direct fluid remedy in the direction of normovolaemic, lowering morbidity and mortality after the crucial operation, according to research.[27]

Virag et al., (2022) studied and reported a systematic review on the use of fluid treatment which enriches GIT recovering subsequent surgical treatment. In comparison to non-goal-directed fluid remedy, goal-directed fluid rehabilitation led to improved gastrointestinal utility recovery in addition to a short halt in the hospital. Our meta-primary analysis concludes that patients who received GDFT during surgery got less fluid, and had subordinate serum lactate stages, as well as together the first flatus and faces performed.[28]

Maintaining proper perfusion and oxygen supply to the tissues during surgery requires meticulous fluid management. Targeting fluid therapy to the demands of the patient is essential because both hypo and hypervolemia can be detrimental.[28] Fluid restriction alone, which is frequently advised as being preferable to a liberal approach, may decrease the flow of blood toward the gastrointestinal tract, which could slow down recovery time for the gastrointestinal system, impair renal perfusion, and increase the potential for acute kidney damage following surgery.[29] Both outcomes may occur more quickly with the pneumoperitoneum. Interstitial oedema, which is brought on by hypervolemia and excessive fluid administration and affects perfusion and oxygen uptake,[30] can also be dangerous and increase the risk of surgical postoperative morbidity.[31]

According to reported outcomes, GDFT might result in a shorter hospital stay. This finding was important and might be regarded as persuasive in clinical practice. This finding is consistent with earlier findings that have been published. However, in the

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studies that used the ERAS, there was no discernible difference. If GDFT paired through ERAS or supplementary fast-track operation methods provide an extra benefit of shorter hospitalization or not, further research is required. One of the most significant observations of the present meta-analysis is that GDFT was associated with speedier gastrointestinal healing as indicated through a lesser duration to the first stool. Even though there is ample proof that any pneumoperitoneum-assisted abdominal surgical treatment may decrease bowel movements, this outcome may only be acknowledged as being particularly significant in subsequent bowel operations.[32]

Aaen et al., (2021) studied and reported a randomized trial of fluid rehabilitation in substitute abdominal surgical procedures. 312 adult patients with gastrointestinal blockage or perforation were included in the study. Subsequently, operation for bowel obstruction or gastrointestinal perforation, flow-guided fluid rehabilitation towards near-maximal stroke volume (TFT group) did not develop the consequence in comparison to pressure-guided intravenous fluid therapy (STD group), although it may have lengthened the hospital stay. With regard to complications and mortality, this randomized multicentric trial of patients having essential treatment regarding GI perforation or obstructive bowel disease revealed no superiority of a flow-guided (TFT) fluid regimen monitored through zero fluid balance over a pressure-guided (STD) fluid regimen.[33]

Brandstrup et al., (2012) studied and investigated perhaps fluid treatment has a purpose of near-maximal stroke volume (SV) in patients suffering colorectal surgical procedures. The objective of near-maximal SV directed using oesophageal Doppler was the fluid therapy objective for 150 patients undertaking the non-compulsory colorectal surgical procedure. Both groups had comparable numbers of patients receiving laparoscopic or open surgery and patient characteristics. Overall, major, minor, cardiac, and tissue-healing problems did not significantly differ between the groups. One patient per group passed away. There was no discernible change in the duration of the halt in the hospital. In patients undergoing elective colorectal surgery, goal-directed fluid treatment to near-maximal SV guided by ED does not provide any additional benefit over fluid therapy utilizing zero balance and normal BW. In summation, the study did not demonstrate any benefit or harm for patients experiencing non-compulsory colorectal operation when ED-guided goal-directed fluid treatment was compared to goal-directed fluid therapy to zero fluid balance.[34]

CONCLUSION

The study has concluded that targeted fluid therapy has been more beneficial than standard therapy for those patients who received orthopedic surgery. The study has shown that TFT reduces the volume of infused fluids during operation and also managed to maintain hemodynamic stability and the gastrointestinal physiology was significantly restored after the surgery, as compared to the standard therapy. The study was done in one center. The multicentre study needs to be conducted in the future to bring a broader conclusion. The study is limited to patients with orthopedic surgeries. Similar studies should be conducted for other studies and disorders of electrolyte imbalances. Overall, this current study has contributed to the clinical management of orthopedic surgeries which is quite common in the surgery department.

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