EGYPTIAN JOURNAL OF ANAESTHESIA
2023, VOL. 39, NO. 1, 687–695
https://doi.org/10.1080/11101849.2023.2247872

Goal-directed fluid therapy compared to liberal fluid therapy in patients subjected to colorectal surgery

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ABSTRACT

Background: The best technique to manage intraoperative fluids during colorectal surgery has never been universally agreed upon. Key organ function is hampered by excessive intraoperative fluid administration: It lengthens and raises the expense of hospitalization by increasing the risk of heart failure that goes along with it, causing gastrointestinal membrane edema, and impeding the recovery of gastrointestinal functions.

Aim and objectives: Thestudy's objective was to evaluate the impacts of goal-directed fluid therapy (GDFT) and liberal fluid therapy (LFT) using cardiometry in candidates with colorectal abnormalities.

Subjects and methods: 100 patients were allocated into two equal groups in a random pattern for this prospective, randomized, controlled trial at the Mansoura oncology center; GDFT group) 50 patients): by using stroke volume optimization and the LFT group (50 patients): by using the traditional technique of fluid administration.

Results: Crystalloid and total fluids were significantly lower among GDFTgroup compared to LFT group. Both lactate and creatinine levels were slightly higher among the GDFT group than the LFT group but without a statistically significant difference. Postoperative complications were comparable between the studied groups.

Conclusions: However, GDFT needs lower total volume of fluids given to the patients it may not enhance patients' postoperative outcomes after colorectal surgery compared to liberal fluid treatment. Moreover, both studied strategies did not affect organ perfusion, although serum lactate and serum creatinine were slightly higher with GDFT.

ARTICLE HISTORY
Received 17 July 2023
Revised 6 August 2023
Accepted 10 August 2023

KEYWORDS
Liberal fluid treatment; mortality; cardiometry; goal-directed fluid therapy; colorectal surgery

1. Background

Treatment of individuals following major abdominal surgery includes fluid Therapy on a regular basis. The anesthetist's primary objective during surgery is to optimize and assess the fluid condition of the patient to enhance the patient's result and to lower morbidity [1].

Hypovolaemia may result in circulatory collapse, surgical complications, and even death [2]. However, recent studies have demonstrated that consuming too much fluid raises the risk of postoperative mortality and complications. Thus, despite significant disagreement regarding how to do so, delivering the appropriate amount of fluid is imperative [3].

Consequently, there has always been discussion surrounding the best technique to manage intraoperative fluids during colorectal surgery. Excessive intraoperative fluid administration leads to increased heart preload, risk of pump failure, edema of the GIT mucosa, and poor recovery of its function. These outcomes extend hospital stays and increase hospital expenses [4].

Historically, there has been a liberal administration of intravenous fluids during surgical procedures, and this is primarily due to concerns regarding preoperative dehydration, destabilization of the circulatory system caused by general and regional anesthesia, insufficient oxygen delivery (especially the bowel), avoidance of unnecessary blood transfusions, and low urine output [5].

Another technique is "the goal-directed," in which fluids are given to obtain the close to maximal stroke volume (S.V.), as identified by an esophageal Doppler. Hypovolemia should be avoided and tissue oxygenation should be enhanced with the heart functioning at the top of the Sarnoff curve (Starling relationship) [6].

Static indices or dynamic indices assess cardiac output. For making judgments on volume replacement, static cardiac parameters of preload like central venous pressure (CVP) and pulmonary artery wedge pressure are not very helpful in identifying the cyclic variation of

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the wave of the arterial pressure in patients on the mechanical ventilator and forecast fluid responsiveness, dynamic indices as pulse pressure variation (PPV) and stroke volume variation (SVV) are being employed more [7].

In high-risk patients, direct assessment of S. V. utilizing non-invasive methods has become acknowledged as a tool for optimizing stroke volume and directing fluid administration [6]. Stroke volume is measured using various methods, such as arterial waveform analysis, bioimpedance/reactance measures, and Doppler monitoring. Therefore, optimizing the stroke volume as the end aim might enhance surgical patient outcomes with accurate fluid dosing predictions [8].

Systemic vascular resistance (SVR), cardiac index (CI), cardiac output (COP), systolic time ratio (STR), and cardiac index (CI) can all be accurately measured using the non-invasive method of impedance cardiography (ICG) [9]. ICG generates waveforms using electrical impedance changes influenced by the force and pace of the left ventricle's contraction and blood pumped volume and velocity. Along with H.R. and B. P., additional hemodynamic parameters such as S.V., COP, and SVR are deduced from that curve [10].

Hence, in this study, we investigated the impacts of GDFT compared to LFT by using non-invasive electrical cardiometry in colorectal surgery on patients' postoperative outcomes. Our hypothesis posits that GDFT is superior to LFT in terms of providing adequate intravascular fluid volume for optimal perfusion, while avoiding the detrimental effects of glycocalyx function impairment due to fluid overload.

2. Materials and methods

The Institutional Review Board (IRB)of the Faculty of Medicine, Mansoura University, gave its clearance R.19.12.704 for this prospective, randomized, open-labeled trial carried out in Mansoura Oncology Center from Jan 2020 to June 2021 after clinical trial registration (NCT 05487222). All participants provided their written, informed permission. Patients prepared for colorectal surgery aged between 30 and 70 met the following criteria: The American Society of Anesthesiology (ASA) grades I and II, Hb >10 g/dl, and Hct > 35% were involved in the study. The exclusion criteria included patient refusal; severe cardiovascular issues (ejection fraction 45%); hepatic malfunction (B, C grade on Child-Pugh); bleeding or clotting issues; and patients with metabolic abnormalities.

A computer-generated randomization sequence was utilized to allocate patients randomly to one of two equal groups the Liberal fluid therapy group (LFT group)($n = 50$) utilizing standard fluid administration methods and the goal-directed fluid therapy group (GDFT group)($n = 50$) employing optimization of the stroke volume using data from the ICON (ICONTM, OSYPKA medical cardiotonic, Elixir, Germany).

3. Anesthetic management

3.1. Preoperative preparation and management

The patient's medical background and physical condition were thoroughly evaluated. Basic demographic information such as age, gender, weight, and height were documented. A battery of diagnostic tests, including complete blood count, international normalized ratio, electrocardiogram, liver function tests, serum creatinine, serum lactate, arterial blood gases, and echocardiography (if deemed necessary), were conducted as part of the routine evaluation. Oxygen saturation, pulse rate, and arterial blood pressure were all measured. Fasting time would be noted. An appropriate intravenous line was placed where basal serum creatinine and lactate were obtained and recorded before surgery. Ultrasound-guided right internal jugular vein catheter was inserted. The application of electrodes from the ICON (ICONTM, OSYPKA medical cardiotonic, Elixir, Germany) was administered to all participants in both cohorts. Specifically, two of the electrodes were placed on the left aspect of the neck, and an additional two were placed on the thorax (left inferior side). Ringer's acetate (500 ml) as a pre-induction infusion solution was initiated. Subsequently, a preoperative administration of 0.03 mg/kg midazolam was administered, followed by the collection of basal readings. Before induction catheter in the epidural space was inserted in all patients to facilitate postoperative analgesia.

4. Intraoperative management

4.1. General anesthesia

Prior to intubation, pre-oxygenation was performed. The induction process involved the gradual IV administration of fentanyl (1µ/kg), propofol (1.5–2.5 mg/kg), and atracurium (0.5 mg/kg) to achieve muscle relaxation and aid in the intubation process. The patients underwent mechanical ventilation with a volume-controlled mode to maintain (ETCO2) levels between 30–35 mmHg. Additionally, a FiO2 of 40% and isoflurane concentration of 1.2–1.5% were administered to maintain sufficient depth anesthesia. Incremental atracurium boluses were used to maintain muscle relaxation. The conventional monitoring method involves using ECG, non-invasive blood pressure, pulse oximetry, and capnography. Upon completion of the surgical procedure, the remaining neuromuscular blockade was counteracted through the intravenous administration of neostigmine and

atropine at doses of 0.04 mg/kg and 0.02 mg/kg, respectively. After fulfilling the extubation criteria, patients were transferred to the post-anesthetic care unit(PACU).

4.2. Liberal fluid therapy group (LFT)

The administration of the Ringer acetate solution was initiated after induction, taking into account the fasting period, maintenance, and third space loss following the surgical incision. The typical infusion rate during colorectal surgery is 6–8 ml/kg/h. This study examines the standard methods for administering intraoperative fluid, taking into consideration various factors such as heart rate (H.R.), mean arterial pressure (MAP), central venous pressure (CVP), and urine output. Hypotension is characterized as a condition in which the patient's Mean Arterial Pressure (MAP) is 20% or lower than their initial MAP and descends below 65 mmHg. In this scenario, the rate of the crystalloid infusion was increased, followed by the initiation of a colloid infusion [6% hydroxy ethyl starch 130/0.4 (Voluven, Fresenius Kabi, Germany)]. If hypotension persisted, a blood transfusion was administered based on the patient's blood loss to maintain the hemoglobin level above 10 g/dl. In persistent hypotension, where fluid and blood levels are insufficient to elevate mean arterial pressure (MAP) above 65 mmHg, a vasoactive agent such as ephedrine was administered in 5 mg boluses, and the dosage was duly documented. The response of the cardiovascular system and the urinary output were observed [11].

4.3. Goal-directed fluid therapy group (GDFT)

The stroke volume(basal) and variance were measured under preoperative sedation with 2 mg of midazolam. Stroke volume response was measured after 200 ml of Colloid was infused over ten minutes gradually. If the stroke volume increases by more than 10% for 20 minutes, the bolus will be administered again. No additional intervention was provided when the stroke volume did not increase by more than 10%. The maximum stroke volume will be determined by the most recent stroke volume with a 10% response (SVmax). Trigger stroke volume is (SVT) defined as the stroke volume that fell intraoperatively by 10% below (SVmax) [12]. Fluids were administered intravenously to keep the stroke volume variance between (8–12%). The IV crystalloid administration rate was slowed if the stroke volume fluctuated less than (8%) and was raised if the stroke volume fluctuated beyond 12%.

Blood lost over 500 ml was replenished 1:1. Ringer solution replaced any blood loss of less than 500 ml. A 200 ml infusion of hydroxy ethyl starch is initiated when the stroke volume falls below SVT. Before contemplating administering inotropes to the patient based on other cardiac characteristics, the patient had three rounds of Voluven infusion.

Also, a vasoactive agent such as ephedrine was given in 5 mg boluses, and dosages were noted when (MAP) dipped below 65 mmHg despite achieving SVopt.

4.4. Outcome measures and recorded data

The primary objectives of the current research are to evaluate the effects of two different protocols on the perfusion of organs, specifically concerning serum lactate and serum creatinine levels. The study's secondary outcomes will encompass assessing hemodynamic stability, quantifying administered fluid and vasoactive agents, and evaluating postoperative adverse effects such as wound infection, ileus, acute kidney injury, and burst abdomen.

Cardiac output non-invasive monitor was used to quantify CVP, S.V., SVV, COP, CI, and thoracic fluid content (TFC), among other hemodynamic indicators. These variables were obtained just after induction (T1), then 30 min (T2), 60 min (T3), 90 min (T4), and 120 min (T5) during surgery.

Non-invasive MAP and H.R. were recorded at the same time points T1, T2, T3, T4, and T5. Volumes of crystalloid, Voluven, blood, and total fluids amount administered were recorded.

Serum lactate and creatinine were obtained at various time points, including before surgery (baseline), immediately after surgery, and 6, 24, and 48 hours post-surgery. Episodes of hypotension were documented alongside the number of ephedrine boluses administered, the cumulative dosage of ephedrine, and the number of patients required vasopressor.

Sample size calculation was derived from the mean difference in blood lactate levels between the goal-directed and conventional groups, as reported in a prior study [13]. The G Power program version 3.1.9.4 was utilized to determine the appropriate sample size for a 2-tailed t test with an effect size of 0.612, α error of 0.05, and a desired power of 80.0%. The resulting sample size was found to be 43 in each group. 15% was added to the total sample size as a dropout, resulting in a final sample size of 50 cases in each group.

The data analysis was conducted using **SPSS software**, specifically version 25, developed by SPSS Inc. under PASW Statistics for Windows version 25. The reference cited is "Chicago: SPSS Inc." The qualitative data were presented in numerical and percentage form – the standard deviation for normally distributed data. The qualitative data were presented as frequencies and percentages. Standard deviation calculation applies to data that follows a normal distribution, which can be confirmed by utilizing the Kolmogorov-

Smirnov test. The obtained results were deemed significant at (≤0.05). The Mann-Whitney U test is a nonparametric inferential statistical test commonly employed to assess the differences between two independent groups. The U test and Student t-test were utilized to compare the two groups under investigation, considering the presence of non-normally distributed and normally distributed data, respectively.

5. Results

The present research tested 117 people. Four patients refused to participate in the research; three had coagulation issues, one had hepatic dysfunction with a Child-Pugh C score of 1, one had renal impairment with a blood creatinine level of 2.9 mg/dl, and four had serum lactate levels more than 2 mmol/L. The 104

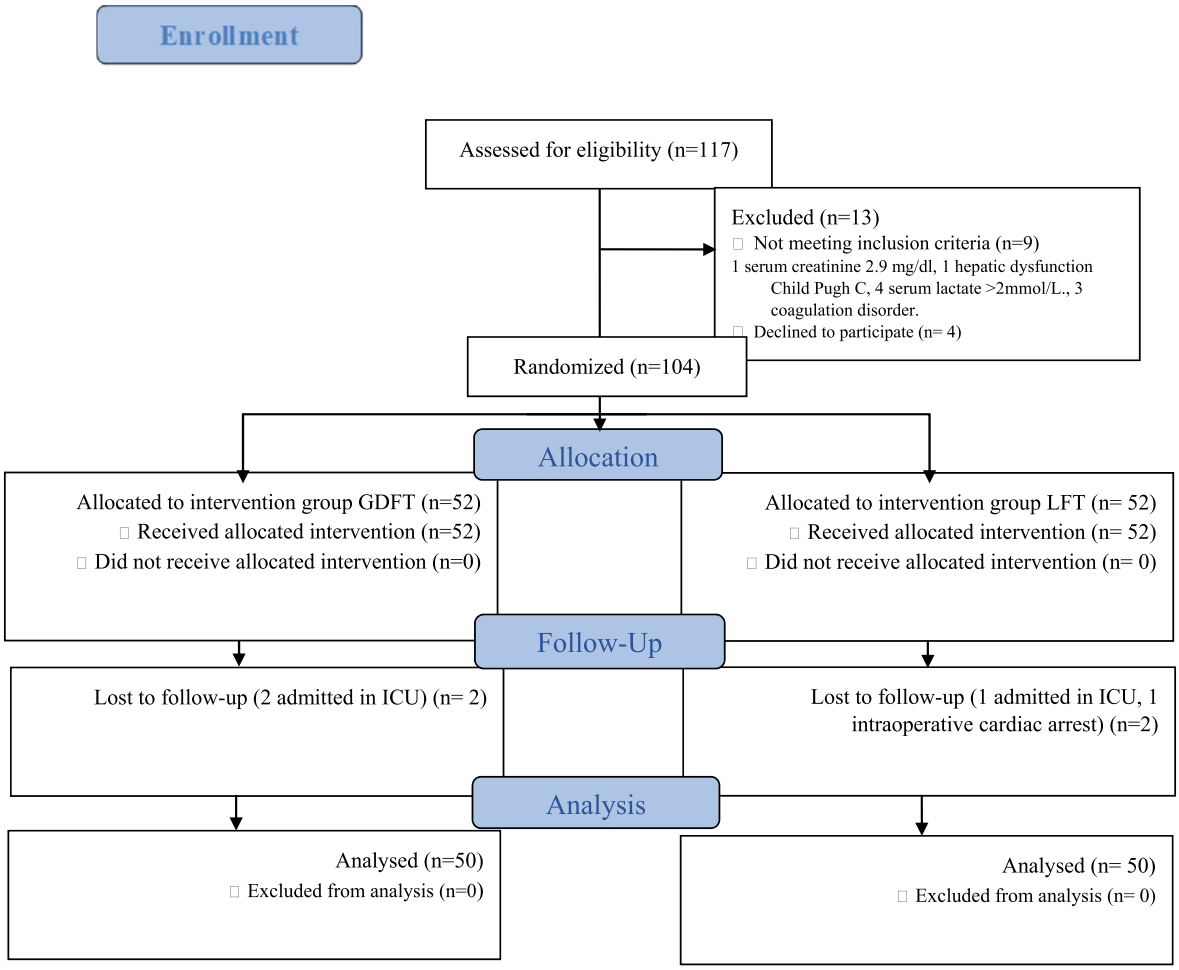

Figure 1. The flow diagram of patient progress through the randomized trial.

Table 1. Demographic data, type of surgery, and operative time comparing the two groups.

	GDFT ($n = 50$)	LFT ($n = 50$)	Pvalue
Age (years)	47.7 ± 9.7	48.1 ± 8.9	0.84
Sex			
Male	33 (66%)	25 (50%)	0.105
Female	17 (34%)	25 (50%)	
BMI (kg/m^2)	28.03 ± 3.91	26.95 ± 4.23	0.187
ASA			
I	30 (60%)	31 (62%)	0.838
II	20 (40%)	19 (38%)	
Type of surgery			
Anorectal cancer	6 (12%)	12 (24%)	0.213
Rectum cancer	0	1 (2%)	
Hemicolectomy	25 (50%)	26 (52%)	
Sigmoid cancer	15 (30%)	10 (20%)	
Total colectomy	4 (8%)	1 (2%)	
Operative time (h)	3.22 ± 0.764	3.10 ± 0.789	0.442

Data is expressed as mean and standard deviation or as percentage and frequency. P is significant when < 0.05. n=Number of patients, BMI=Body mass index, ASA= American Society of Anesthesiologists, GDFT=Goal directed fluid therapy group, LFT=liberal fluid therapy group.

remaining patients were divided among the groups in this clinical experiment. Two patients from the GDFT group were sent to the ICU, while one from the LFT group had intraoperative cardiac arrest, and another was transferred to the ICU. The findings of 50 patients from each group were subsequently evaluated (Figure 1).

Between the studied groups, there were no appreciable differences in the patients' demographics, type of surgery, or procedure length (Table 1). Also, the studied groups' intraoperative and postoperative measurements for H.R., MAP, CVP, and S.V. were comparable (Table 2). Readings taken intraoperatively for SVV, COP, CI, and TFC were also comparable (Table 3). The serum lactate and creatinine levels of the GDFT group were slightly elevated compared to those of the LFT group, although this difference did not reach statistical significance (Figures 2, 3). Concerning the

Table 2. Clinical parameters.

	GDFT ($n = 50$)	LFT ($n = 50$)	P value
H.R. (bpm)			
T1	80.66 ± 9.15	80.20 ± 8.74	0.798
T2	80.3 ± 8.7	77.78 ± 12.86	0.244
T3	77.06 ± 8.26	79.48 ± 8.98	0.325
T4	79.52 ± 8.19	79.22 ± 10.15	0.871
T5	83.66 ± 6.60	85.80 ± 8.26	0.156
MAP (mmHg)			
T1	90.32 ± 6.29	88.06 ± 8.96	0.148
T2	86.02 ± 9.03	83.46 ± 9.09	0.161
T3	91.92 ± 8.06	90.72 ± 7.05	0.430
T4	83.48 ± 9.70	86.72 ± 8.72	0.082
T5	90.72 ± 9.42	92.36 ± 5.93	0.300
CVP (cm H2O)			
T1	4.94 ± 1.15	5.40 ± 1.87	0.142
T2	7.50 ± 1.28	8.08 ± 2.20	0.111
T3	10.30 ± 1.58	10.58 ± 1.60	0.382
T4	10.62 ± 1.61	11.10 ± 1.68	0.149
T5	11.16 ± 1.28	11.64 ± 1.57	0.098
SV(ml)			
T1	71.98 ± 6.66	72.42 ± 825	0.770
T2	68.56 ± 6.46	70.22 ± 6.47	0.202
T3	77.82 ± 5.92	79.62 ± 6.98	0.168
T4	73.80 ± 6.66	74.88 ± 5.95	0.395
T5	75.88 ± 5.26	77.54 ± 5.52	0.127

Data is expressed as mean and standard deviation. P is significant when <0.05. n=Number of patients, HR=Heart rate, MAP= Mean arterial pressure, CVP=Central venous pressure, SV= Stroke volume, (T1)=after induction of anesthesia, (T2) = 30 min, (T3) = 60 min, (T4) = 90 min, (T5) = 120 min during surgery, GDFT=Goal directed fluid therapy group, LFT=liberal fluid therapy group.

Table 3. Clinical parameters (continue).

	GDFT ($n = 50$)	LFT ($n = 50$)	P value
SVV (%)			
T1	11.18 ± 2.11	11.32 ± 1.53	0.705
T2	11.06 ± 2.34	11.24 ± 1.98	0.679
T3	10.54 ± 1.69	11.12 ± 2.24	0.147
T4	10.30 ± 1.92	10.82 ± 1.86	0.172
T5	10.0 ± 0.926	10.42 ± 2.05	0.190
COP (L/min)			
T1	5.58 ± 0.905	5.68 ± 0.819	0.564
T2	5.38 ± 0.752	5.42 ± 0.928	0.813
T3	5.76 ± 0.687	5.94 ± 0.935	0.275
T4	5.66 ± 0.798	5.90 ± 0.863	0.152
T5	6.20 ± 0.534	6.28 ± 0.701	0.523
CI ($L/min/m^2$)			
T1	2.98 ± 0.88	3.06 ± 0.424	0.438
T2	2.94 ± 0.314	3.02 ± 0.553	0.376
T3	3.16 ± 0.422	3.26 ± 0.443	0.251
T4	3.08 ± 0.528	3.16 ± 0.509	0.443
T5	3.28 ± 0.834	3.38 ± 0.490	0.467
TFC ($kOhm^{-1}$)			
T1	30.98 ± 3.73	31.26 ± 4.87	0.748
T2	31.66 ± 3.19	32.84 ± 4.46	0.131
T3	33.18 ± 3.29	34.12 ± 4.19	0.216
T4	33.38 ± 4.27	34.64 ± 4.39	0.149
T5	36.92 ± 4.29	37.80 ± 4.78	0.335

Data is expressed as mean and standard deviation. P is significant when <0.05. n=Number of patients, SVV=Stroke volume variation, COP= Cardiac output, CI=Cardiac index, TFC= Thoracic fluid content, (T1)=after induction of anesthesia, (T2) = 30 min, (T3) = 60 min, (T4) = 90 min, (T5) = 120 min during surgery, GDFT=Goal directed fluid therapy group, LFT=liberal fluid therapy group.

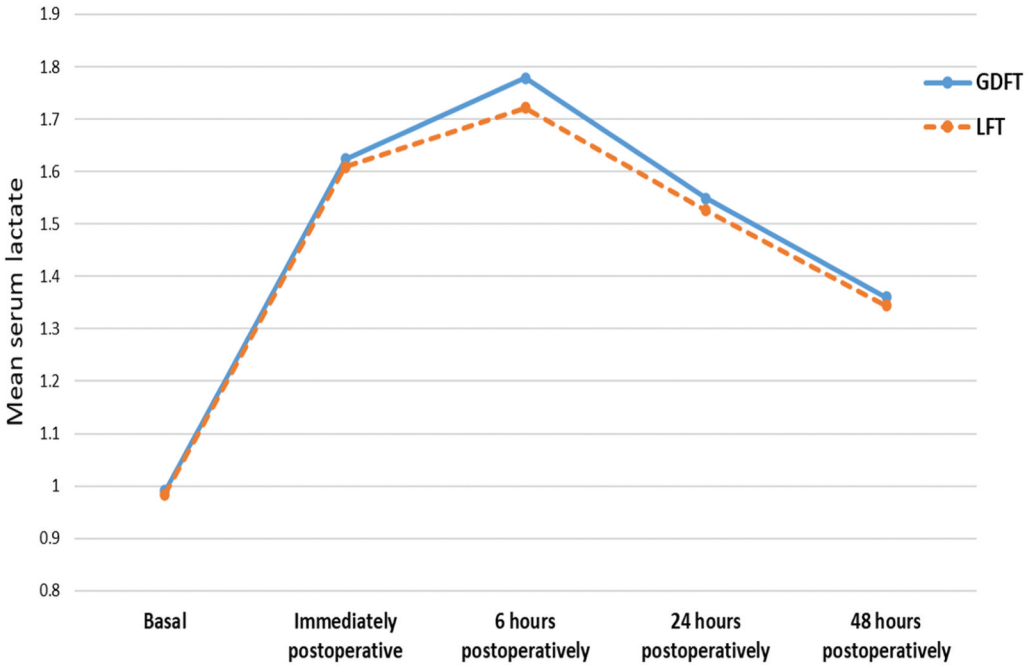

Figure 2. Serum lactate during follow up among studied groups. GDFT=Goal directed fluid therapy group, LFT= Liberal fluid therapy group

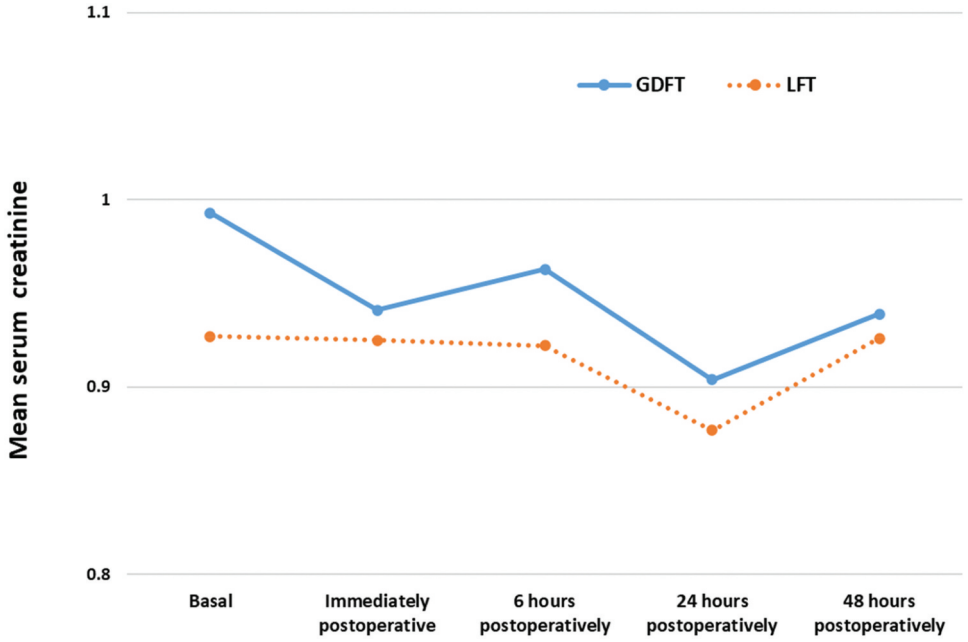

Figure 3. Serum creatinine during follow up among studied groups. GDFT=Goal directed fluid therapy group, LFT= Liberal fluid therapy group

administration of fluids during surgery, it was observed that patients with liberal fluid therapy (LFT) required significantly higher amounts of crystalloid fluids, with a median volume of 2915 mL (range: 1736–4189 mL), compared to patients undergoing goal-directed fluid therapy (GDFT), who had a median volume of 2272 mL (range: 1352–2964 mL). This difference was found to be significant ($P < 0.001$).

In contrast, there was a marginal increase in the amount of Voulven administered to patients in the GDFT group (median: 450 ml, range: 100-1000 ml) compared to those in the LFT group (median: 400 ml, range: 100-1000 ml). However, this difference was not statistically significant ($P = 0.208$). The research revealed a statistically significant disparity in the overall quantity of fluids administered, with LFT recording a mean volume of 3900 ml (range: 2650 ml-5500 ml) and GDFT recording a mean volume of 3400 ml (range: 2000–4400 ml). This difference was determined to be statistically significant, as indicated by a p-value of 0.001. The data presented in Table 4 does not show a significant

Table 4. Fluid management.

	GDFT ($n = 50$)	LFT ($n = 50$)	P value
Crystalloid (ml)	2200(1300–2900)	2900(1500–4150)	**<0.001**
Voluven (ml)	450(100–1000)	400(100–1000)	0.208
Blood (ml)	500(250–1500)	500(400–1500)	0.427
Total fluids (ml)	3400(2000–4400)	3900(2650–5500)	**0.001**

Data is expressed as median (minimum-maximum). P is significant when <0.05. n=Number of patients, GDFT=Goal directed fluid therapy group, LFT=liberal fluid therapy group.

Table 5. Hypotensive episodes and ephedrine.

	GDFT ($n = 50$)	LFT ($n = 50$)	P value
Hypotensive episodes			
None	33 (66%)	36 (72%)	0.793
1	15 (30%)	12 (24%)	
2	2 (4%)	2 (4%)	
Ephedrine bolus			
None	37 (74%)	42 (84%)	0.425
1	11 (22%)	8 (16%)	
2	1 (2%)	0	
3	1 (2%)	0	
Ephedrine total amount	10 (5–30)	10 (5–10)	0.08

Data is expressed as number and percentage or median (minimum-maximum). P is significant when < 0.05. n=Number of patients, GDFT=Goal directed fluid therapy group, LFT=liberal fluid therapy group.

Table 6. Complication distribution among studied groups.

	GDFT ($n = 50$)	LFT ($n = 50$)	P value
Burst abdomen	0(0%)	0(0%)	
Paralytic ileus	1(2%)	2(4%)	0.558
Wound infection	2(4%)	3(6%)	0.646
AKI	1(2%)	2(4%)	0.558

Data is expressed as percentage and frequency. P is significant when < 0.05.

difference in the amount of blood given between the two groups under investigation. Moreover, no statistically significant difference was observed between the two groups being studied in terms of hypotensive episodes, the usage of ephedrine by patients, and the total amount of ephedrine administered (Table 5). post operative complications were comparable between the studied groups (Table 6).

6. Discussion

The current study's findings indicate significant differences in the crystalloid and total fluids levels between the group that received GDFT and the group that received LFT. However, no statistically significant difference was observed in the serum lactate and serum creatinine levels between the GDFT group and the LFT group, although there was a slight increase in these levels in the GDFT group. The hemodynamic variables recorded and postoperative complications were comparable between both studied groups. Also, both groups had comparable hypotensive episodes and vasoactive agent doses.

Intraoperative fluid treatment may impact the patient's intraoperative stability and postoperative recovery [14].

Several published meta-analyses have compared GDFT with other fluid treatment strategies in colorectal surgery. The investigations included in these meta-analyses, however, only employed esophageal Doppler monitor in the GDFT group, and they were published in the past with a limited number of RCTs [15].

So in the present study with patients who underwent colorectal surgery, we sought to evaluate the influence of GDFT and LFT by using non-invasive electrical cardiometry on patients' postoperative outcomes.

The current research indicated comparable parameters between the two groups regarding heart rate. The findings are consistent with those of Summit et al., who compared GDFT using Trans Esophageal Echo and Conventional Fluid protocol during Cerebral Aneurysm clipping. The present study observed no significant mean arterial blood pressure disparity among the two cohorts. Additionally, there was no noteworthy difference in the follow-up of central venous pressure between the groups, despite a slightly elevated reading in the LFT group [16]. As mentioned earlier, the findings are consistent with Cesur et al., who reported in a study involving a sample of seventy patients who underwent elective gastrointestinal surgeries. The patients were randomly allocated to conventional or GDFT based on the plethysmography variability index (PVI). The results of the study indicated that there was no significant difference in mean blood pressure (MBP) in the two studied groups [17].

The current investigation assessed stroke volume and stroke volume variation (SVV) and showed comparable results between the two cohorts throughout the surgical procedure. Scheeren et al. concurred with the findings of the present investigation pertaining to monitoring stroke volume and volume variation.

Furthermore, the present study demonstrated that cardiac output and cardiac index were comparable in the measurements between the studied groups during the surgical procedure, which goes with the findings reported by Scheeren et al. [18]. The present investigation revealed an absence of statistically significant distinction between the readings observed in both cohorts with respect to the serum lactate level. Moreover, the serum creatinine levels exhibited an insignificant variance between the two cohorts. While there was a slight elevation in serum lactate and serum creatinine levels in the GDFT group compared to the LFT group, the difference was not statistically significant. The measurement of lactate concentration is

a highly responsive yet indirect marker of the adequacy of blood flow to organs [19]. In their research, Sujatha et al. investigated the effectiveness of goal-directed versus traditional approaches in open major bowel surgery. The study involved a total of 306 patients who were divided into three groups, each consisting of 102 patients. These groups were labeled as control (conventional), PVI, and Flo trac. Despite the significant increase in post-surgery lactate levels across all three groups, no significant differences were observed at various time intervals [20].

Cesur et al. conducted a study comparing traditional fluid protocol with PVI-based goal-driven fluid protocol in elective gastrointestinal surgery. They found that both protocols resulted in similar alterations in lactate levels, which serve as an indicator of organ perfusion. Upon analysis of the creatinine values, no statistically significant difference was observed between the two groups. Furthermore, the postoperative creatinine values did not exhibit any significant changes in accordance with the AKI criteria compared to the initial values [17].

With respect to the fluids administered to patients during surgery, the present study revealed that patients in the LFT group required notably more significant quantities of crystalloid (2915 [1736–4189]) than those undergoing goal-directed fluid therapy (GDFT) (2272 [1352–2964]), with a statistically significant p-value of less than 0.001. Moreover, a statistically significant larger total fluid volume was observed in LFT (3772; 95% CI: 2220–5376) versus GDFT (2800.5; 95% CI: 1803–4386), with a p-value of 0.001.

In contrast, GDFT patients needed slightly larger Voulven 447(42–1048) than LFT patients 415.5(5.0–795) but without significant difference with p-value = 0.264. Sujatha and colleagues observed that the control group (comprising of LFT patients) received a significantly higher amount of crystalloids, a smaller volume of colloids, and a larger net volume of fluid in Comparison to the other two groups. The administration of fluids was similar in both the PVI and FloTrac groups [20]. The findings of Cesur et al. corroborate our results, indicating that a significantly greater amount of crystalloid and overall fluid volume is required in LFT compared to GDFT [17]. According to Cecconi et al., patients managed with a goal-directed protocol for their fluid requirements were administered more colloids than those who underwent standard or restrictive fluid management [21].

In contrast to our findings, Benes et al. reported a reduction in hypotensive episodes in the group receiving goal-directed fluid therapy (GDFT) using stroke volume variation (SVV) as a fluid administration marker compared to the control group receiving routine intraoperative care [22]. Our study did not reveal any significant difference between the two groups, which could be attributed to administering a larger volume of crystalloid in the liberal fluid therapy (LFT) group and a larger volume of Colloid in the GDFT group.

The current study found no statistically significant difference between the two groups under investigation in terms of the total amount of ephedrine administered and the number of patients requiring vasopressors for episodes of hypotension. Pestana et al. conducted a study to compare the effectiveness of goal-directed fluid therapy using non-invasive cardiac output monitoring techniques with a control group. The study included 142 patients who were undergoing major gastrointestinal surgeries. Fluids were administered to patients in the GDFT group in order to maintain a minimum mean arterial pressure (MAP) of 65 mmHg and a cardiac index (CI) of at least 2.5 L/min/m2. The results of the study revealed that there were no statistically significant differences observed in hemodynamics and postoperative complications. In addition, both groups were administered nor-epinephrine, and no statistically significant difference was observed between the investigated groups [23].

The present investigation revealed that there was no significant difference in the occurrence of postoperative complications, specifically Acute Kidney Injury (AKI) and Wound Dehiscence, between the two groups; this runs with a study conducted by Gomez et al., in which laparoscopic colorectal surgery patients were divided into two groups: goal-directed fluid and control. The researchers found no statistically significant difference in clinical outcomes or postoperative complications, including paralytic ileus, wound dehiscence, and length of hospital stay, between the two groups [14].

Regarding limitations, Excluding patients with a higher risk of undergoing major surgeries warrants further investigation in future studies. Possible academic rewrite: Potential late complications may have been overlooked due to the limited follow-up period that ended at hospital discharge.

7. Conclusions

The application of electrical cardiometry in goal-directed fluid therapy has been associated with a statistically non-significant reduction in the occurrence and intensity of hypotensive episodes. Additionally, this method effectively preserves hemodynamic stability and guarantees sufficient plasma volume status while minimizing the overall quantity of fluid administered to individuals. Moreover, it has been noted that this particular technique exhibits a lesser influence on organ perfusion in Comparison to the more lenient approach to fluid therapy. Notably, no significant disparities in complications were observed between the two groups being examined.

Disclosure statement

No conflict of interest was reported by the author(s).

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