MAK HILL Publications Research Journal of Medical Science

Research Article
doi: 10.36478/makrjms.2023.317.323

Periopreative Goal Directed Fluid Therapy Versus Restrictive Fluid Therapy for Adults Undergoing Major Abdominal Surgeries

[1]Kalpana Verma, [2]Anil kumar Panwar, [1]Kakarla Mourya, [1]Vigya Goyal and [3]Birbal Baj

[1]*Department of Anaesthesia, MGUMST, Jaipur, India*
[2]*Department of General Medicine, MGUMST, Jaipur, India*
[5]*Department of Organ Transplant Anaesthesia, MGUMST, Jaipur, India*

OPEN ACCESS

Key Words
GDFT, MAP, PPV, RFT

Corresponding Author
Vigya Goyal,
Department of Anaesthesia, MGUMST, Jaipur, India

Received: 19 June 2023
Accepted: 27 June 2023
Published: 3 July 2023

Citation: Kalpana Verma, Anil kumar Panwar, Kakarla Mourya, Vigya Goyal and Birbal Baj, 2023. Periopreative Goal Directed Fluid Therapy Versus Restrictive Fluid Therapy for Adults Undergoing Major Abdominal Surgeries. Res. J. Med. Sci., 17: 317-323, doi: 10.36478/makrjms.2023.317.323

Copy Right: MAK HILL Publications

ABSTRACT

Fluid therapy is an important linchpin in perioperative management and it may influence clinical outcome and the use of health care resources, particularly after major surgery. to compare the clinical impact of intraoperative goal directed fluid therapy versus restrictive fluid therapy in patients undergoing major abdominal surgery. A total of 60 patients were randomized in the goal-directed fluid therapy and restrictive fluid therapy groups. In case of goal directed fluid therapy (GDFT) baseline readings of pulse pressure variation (PPV) will be noted and PPV will be maintained in between 10-13%. The primary goal was to see for fluid related complications and length of hospital stay. Secondary goal is hemodynamic changes. In case of restrictive fluid therapy (RFT) fluid was given at fixed rate of 4 mL kg^{-1}. Phenylephrine 10 mcg iv bolus dose was given to maintain mean arterial pressure (MAP) above 65 mm Hg when there was drop in MAP <65 mm Hg. Intra operatively, the goal-directed fluid therapy group received higher intravenous fluid volumes (mean of 1125 mL for each surgery and standard deviation of 255.002) compared with the restrictive fluid therapy group (mean of 713.33 mL for each surgery and standard deviation of 142.595, p<0.001). We concluded that Goal-directed fluid therapy and a restrictive fluid therapy regimen are equally effective and don't have any additional benefits over one other regarding fluid related complications, length of hospital stay and haemodynamic stability, when used in major abdominal surgeries.

INTRODUCTION

Fluid therapy is an important linchpin in perioperative management and it may influence clinical outcome and the use of health care resources, particularly after major surgery[1,2]. The information suggests that ''liberal'' intraoperative fluid resuscitation is detrimental in open major abdominal surgeries and on the other hand restrictive fluid therapy has superior outcomes, including reduced postoperative complications and discharge time[3,4].

Fluid overload might result's in interstitial oedema, increased cardiorespiratory workload and body weight gain, whereas over-restricted/scanty fluid administration may lead to poor intravascular volume, tissue hypoperfusion, cellular oxygenation impairment, acute kidney injury and potential organ dysfunction, which leads to rise in the complication rate, hospital stay and mortality. Both methods are been linked with impaired and defective wound healing and outcomes[5,6[.

A traditional liberal fluid strategy tells us that anaesthesia induced vasoplegia causes a reduction in the circulating volume of blood and, at the same time, surgical inflammation creates a leak allowing fluids to move from the intravascular into the interstitial compartment. Both methods show that, in order for intravascular volume to increase and oxygen transport capacity to be maintained, further IV fluids are needed. However, since transient and predominantly localized changes in vascular permeability are common within injured tissues, the significance of so called non anatomical surgical or 3rd space surgery has been exaggerated[7,8].

To provide cost-effective perioperative care today, Enhanced Recovery After Surgery (ERAS) programmes have been widely adopted. A big focus of these programmes is fluid control, which helps patients recover physiologically[8,9]. The volume of fluids to be administered, the indications for utilising vasopressors or inotropes and the physiologic goals to be met are the subject of intense scientific discussions. In order to guide fluids and cardiovascular medications, goal-directed fluid therapy (GDFT) necessitates close monitoring of the stroke volume, pulse pressure variation, stroke volume index and mean arterial pressure.

On the other hand, restriction fluid therapy (RFT) only required the administration of vasopressors together with a predetermined rate of crystalloid infusion to lessen the vasodilatory effects of anaesthetic drugs and/or neuraxial block[7].

As a guidance for intravascular fluid administration in the fluid therapy, the PPV are been used.

The PPV (%) is calculated using the following equation:

$$\text{PPV (\%)} = \frac{200\times \text{ppmax-ppmin}}{\text{ppmax+ppmin}}$$

where, PPmax and PPmin represent the highest and lowest values of pulse pressure experienced during one respiratory cycle. Over three successive respiratory cycles, the PPV (%) is tri-plicated. For the analysis, the mean value of the three variables was employed.

There is some evidence that the GDFT is related with decreased postoperative morbidity compared to the liberal method from more than 45 randomised controlled studies (RCT)[10-12], although newer well-controlled trials have failed to show beneficial therapeutic outcomes. Even though concerns have been raised about the potential of acute renal injury, fewer trials utilising RFT have proven positive outcomes.

According to three short trials that have compared GDFT to RFT thus far, there is no change in the frequency of problems following major abdominal surgery[13-15]. We conducted an RCT to compare the clinical impact of intraoperative GDFT with RFT in patients undergoing major abdominal surgery in light of ambiguities regarding the favourable impact of GDFT and RFT as well as the current advancements in overall perioperative care.

MATERIALS AND METHODS

A hospital based prospective Comparative study on 60 patients who were undergoing major abdominal surgeries at a tertiary care centre, Jaipur. Approval from the institutional ethical committee (dated 07-01-2021, Letter No. MGMCH/IEC/JPR/2021/1164) and informed consent from patients, detailed history and routine investigations were done.

After doing the Pre-Anaesthetic Check-up and obtaining written informed consent, Patients of each group, were taken into the operating room. In addition to routine monitoring, A 20-G arterial cannula is inserted in the non -dominant hand after performing modified ALLEN'S test for invasive arterial pressure measurement. The monitoring transducer is positioned and zeroed at the level of heart. The heart rate, the mean arterial pressure (MAP) and PPV are monitored continuously. Patients were divided into two groups 30 patients are given GDFT (group A) and another 30 given RFT (group B).

In case of RFT fluid will be given at fixed rate of 4 mL kg^{-1}. Phenylephrine 10mcg iv bolus dose is given to maintain MAP above 65 mm Hg when there is drop in MAP <65 mm Hg. In case of GDFT baseline transfusion rate is fixed as 2 mL kg^{-1}, baseline readi ngs of PPV will be noted and PPV will be maintained in between 10-13%. 200 mL of fluid will be given over a period of 10 min, if PPV is >13%, an additional bolus of 200 mL fluid will be given over the next 10 min, if there is no increase in PPV or it is less than 13%. No more bolus of fluid will be given. The process will be repeated until the increase in PPV with the fluid therapy within 13%. Phenylephrine 10 mcg iv bolus dose is given to maintain MAP above 65 mm Hg when there is drop in MAP <65 mm Hg after giving three boluses of fluid or when there is some unexpected sudden drop in MAP (like sudden blood loss during surgery).

Patients with peak airway pressures exceeding 40 mm Hg are excluded from the study. Anaesthesia was discontinued when the surgery got completed and 1 g of paracetamol intravenously was given for analgesia 30 min before the end of the surgery.

In post operative period a baseline fluid administration of 1.5-2 mL kg^{-1} body weight is given. Patient total intake of fluid and output have been monitored for 48 hrs post operatively along with serum electrolytes, lactate and RFT's.

The outcomes or the observations measured were age, gender, anthropometry, co-morbidites, hb, wbc, platelets, serum electrolytes, RFT, H.R, SBP, DBP, MAP, urine output, inotropes, total fluid, total urine output, time, length of hospital stay, day 1 and 2 serum electrolytes, RFT and total intake and output of fluid.

Statistical analysis: Thus collected data was entered into Excel spreadsheet and with the help of Epi Info software CDC USA analysis was done. Level of significance was set at $p\leq 0.05$.

RESULTS

The demographic values of the study subjects are comparable in both the groups (Table 1), when investigations are compared pre and post operatively there is a significant change in p value of chlorine Cl^{-} (p = 0.84) while rest of the investigative values are comparable Hb (p = 0.44), Wbc (p = 0.29), Plt = 0.51, Sr.Urea (p = 0.42), Sr. Creatinine (p = 0.92), Na^{+} (p = 0.3, K^{-} (p = 0.51) (Table 2).

The heart rate is significantly higher in group 2 at 75, 90, 135, 150 and 165 min (p-value at 75 min = 0.01, 90 min = 0.03, 135 min = 0.009, 150 min = 0.01, 165 min = 0.03, respectively) when compared to group 1 during intraoperative period (Fig. 1). There is also a significant decrease in group 2 as compared to group 1 in MAP value at 60 min (p = 0.04), 75 min (p = 0.04), 120 min (p = 0.04) and 135 min (p = 0.04), respectively (Fig. 2).

There is a significant decrease in urine output with p-value at 60 min (0.001), 90 min (0.001), 120 min (0.001) and 180 min (0.04), respectively during intraoperative period in group 2. In case of total urine output group 1 mean urine output is 327 mL as compared to 270 mL in group 2 which is statistically lower with p value of (0.01) and significant (Fig. 3).

In group 1 two patients required inotrope boluses once and two patients required it twice. In group 2, 10 patients required inotropes bolus once and 1 patient

Table 1: Demographic data

Variables	Group 1	Group 2	p-value
Age (Mean±SD)	39.63±10.833	42.83±9.248	0.81
Gender (f/m)	11/19	14/16	0.43
Height(cm)	169±4.44	169.03±5.46	0.97
Weight (kg)	64.67±6.59	64.63±8.87	0.98
HTN	4	3	0.92
HTN/DM	4	4	--

Table 2: Blood report

Mean±SD		Group 1	Group 2
Hb	Pre	12.09±1.17	12.12±1.16
	Post	10.933±1.304	11.17±1.08
WBC	Pre	8353.66±2019.23	8382.66±2391.02
	Post	8209.00±1527.64	7837.00±1189.76
Platelets	Pre	2.32±0.49	2.28±0.509
	Post	2.41±0.49	2.33±0.48
Surea	Pre	29.40±9.66	29.26±6.88
	Post	26.42±6.207	27.56±4.63
Screatinine	Pre	0.803±0.209	0.82±0.15
	Post	0.80±0.16	0.803±0.103
Na	Pre	133.86±2.89	133.76±3.42
	Post	134.80±1.56	133.73±5.43
K	Pre	4.14±0.48	4.13±0.52
	Post	4.08±0.309	4.03±0.33
Cl	Pre	104.67±3.36	104.67±3.36
	Post	105.07±3.83	106.46±3.87

Table 3 Outcome

Outcomes	Group 1	Group 2	p-value
Total fluid	1125.00±255.002	713.33±142.59	0.001 (S)
Total urine output	327.00±77.73	270.00±87.62	0.001 (S)
Time (min)	157.17±20.07	160.00±19.02	0.57
Hospital stay	5.60±0.62	5.57±0.67	0.84

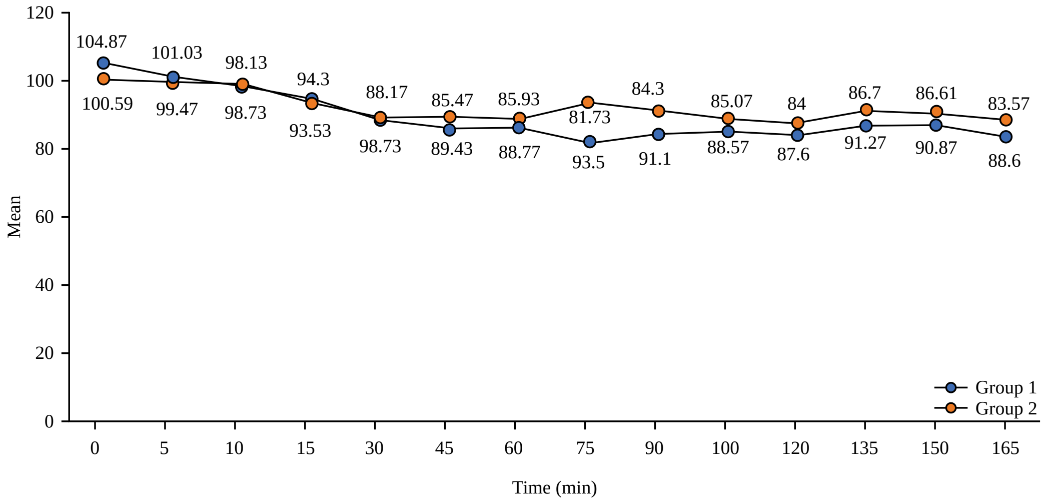

Fig. 1: Heart rate

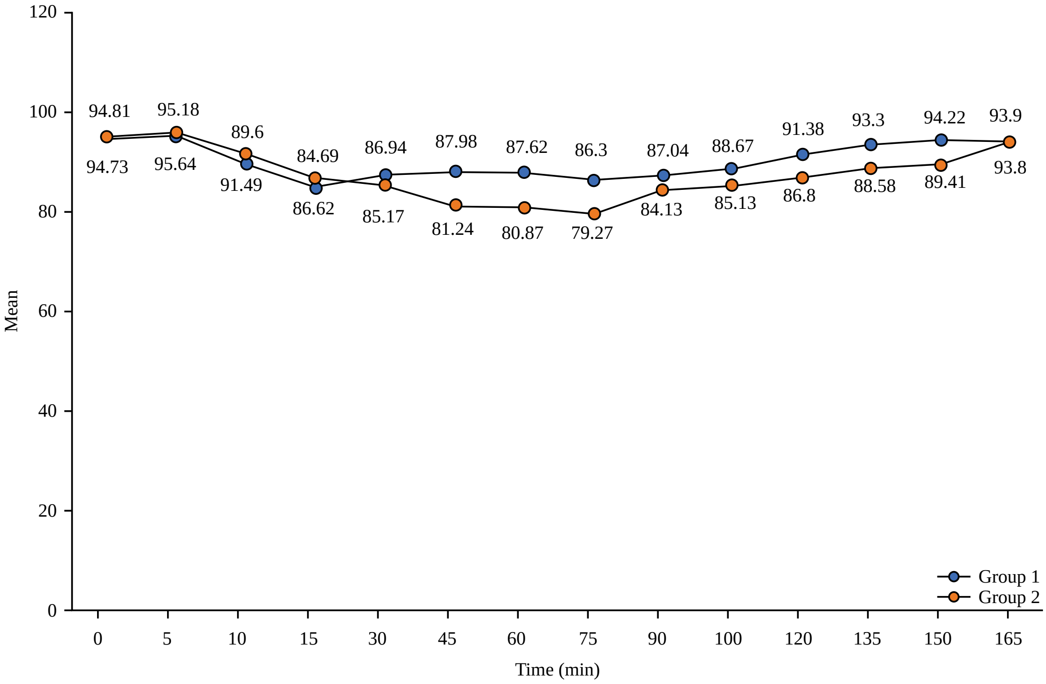

Fig. 2: MAP (mm of Hg)

Table 4: Inotropes use

	Group 1		Group 2		Total		
Inotropes	No.	Percentage	No.	Percentage	No.	Percentage	p-value
1.00	2	50.0	10	90.9	12	80.0	0.89
2.00	2	50.0	1	9.1	3	20.0	

required it twice but use of inotropes in both groups is comparable and statistically non-significant with p-value (0.89) (Table 4).

In group 1 mean requirement of the fluid was 1125ml as compared to 713.33 mL in group 2, which is statistically significant with p = 0.001. The length of hospital stay was 5.6 days in group 1 as compared to 5.57 days in group 2 which is comparable and statistically non-significant with p-value 0.84 (Table 4).

DISCUSSIONS

The management of perioperative fluid replacement is a challenging problem. Goal-directed fluid treatment has recently been added to clinical practise as a component of perioperative care. We are aware of very few studies that directly compare the outcomes of patients undergoing major abdominal surgeries when an

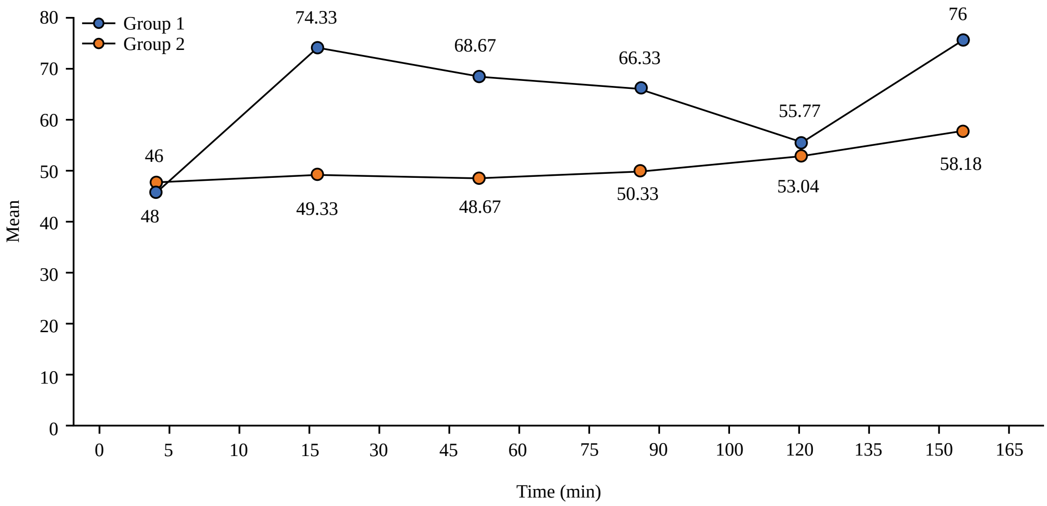

Fig. 3: Urine output

intraoperative restricted v/s goal-directed approach with a PPV and MAP-directed protocol is used.

To avoid both fluid overload owing to an unnecessary infusion and hypoperfusion due to volume depletion, accurate and early identification of intravascular fluid volume status is crucial. In order to manage intraoperative fluid, appropriate hemodynamic monitoring is required.

A straightforward, logical and trustworthy approach to achieving this objective would be suitable for routine intraoperative use. For intraoperative fluid therapy, PPV measurement using a multiparameter monitor, which is often used in clinical practise, has been described and used successfully. Aside from artery catheterization, there are no other costs or complications related to this type of PPV monitoring. For surgical patients, PPV monitoring has been advised to direct volume expansion. Numerous studies indicate that PPV, which was derived from the Datex method, was superior than CVP measurement for assessing intravascular volume and similar with stroke volume variation (SVV) utilising the FloTracTM/VigileoTM system[16].

Numerous research have investigated the impact of intraoperative fluid injection volume on postoperative results. In major abdominal surgery, a restrictive intraoperative and postoperative fluid protocol has been shown to improve wound and anastomotic healing, shorten hospital stays and prevent perioperative complications like cardiopulmonary events and bowel motility disturbances. Additionally, a number of research looked at the impact of intraoperative fluid treatment on perioperative outcomes when it was directed at other hemodynamic targets, such as traditional hemodynamic parameter-guided and functional hemodynamic parameter-directed fluid therapy. Studies showed that after haemodynamic parameter guided (ppv or svv) fluid therapy in major surgeries, patient outcomes improved.

As a result, two ideal intraoperative strategies- restrictive and goal-directed fluid therapy have been suggested. But when compared to patients who received restrictive fluid therapy, individuals who received goal-directed fluid therapy received more fluid.

PPV is thought to be more trustworthy than SVV and can be used to analyse volume contraction before other indicators can. Amplified PPV, however, does not indicate hypovolemic state, such as anaesthesia or inflammation-induced vasodilation. Therefore, it has been recommended to use restricted fluid treatment after abdominal surgery in addition to vasopressor administration to avoid fluid retention after the anaesthetic effects have worn off.

However, the most recent randomised studies did not support the potential advantages of fluid restriction in patient outcomes following elective surgery.

We have seen that there is an increase in H.R in the RFT when compared with GDFT group during intraoperative period. The heart rate is significantly higher in group 2 at 75, 90, 135, 150 and 165 min with (p at 75 min = 0.01, 90 min = 0.03, 135 min = 0.009, 150 min = 0.01, 165 min = 0.03, respectively) when compared to group 1 , along with more requirement of inotropes as there is decrease in MAP. In our study we have seen that the intra-op MAP was significantly lower in RFT group at 60 min (p = 0.04), 75 min (p-0.04), 120 min (p = 0.04) and 135 min (p = 0.04), respectively when both the groups are compared.

Studies have shown that use of inotropes for maintenance of MAP are more beneficial than giving fluid for achieving targeted MAP[2]. It lead to decrease in post op anastomotic leak in in the surgical sites and better outcome.

We in our study also observed that there is no decrease in urine output of the patients who received either RFT or GDFT. All the patients had urine output more than 0.5 mL kg^{-1} hrs^{-1} at all time; but there is a significant difference in urine output in both the groups at 60 min (p = 0.001), 90 min = 0.001), 120 min (0.001) and 180 min (0.04), respectively with RFT group recording lower urine out- put. The remaining p-values are comparable and statistically non-significant with p = 0.59 at 30 min and (0.47) at 150 min. The urine output of the patients also remained more than 0.5 mL kg^{-1} b.wt., which implies that renal function of the patient is normal and not affected.

There was significant difference in total urine output in intraoperative period with RFT group recording lower urine output. The urine output of the patients also remained more than 0.5 mL kg^{-1} b.wt., at all time intervals; which implies that renal function of the patient is normal and not affected. Urine output at post operative day 1and day 2 in both the study groups was comparable and statistically non significant which shows that renal perfusion and excretory functions of kidneys are well maintained in both the groups.

CONCLUSION

We concluded that Goal-directed fluid therapy and a restrictive fluid therapy regimen are equally effective and don't have any additional benefits over one other regarding fluid related complications, length of hospital stay and haemodynamic stability, when used in major abdominal surgeries.

REFERENCES

1. Chan, S.T.F., C.R. Kapadia, A.W. Johnson, A.G. Radcliffe and H.A.F. Dudley, 1983. Extracellular fluid volume expansion and third space sequestration at the site of small bowel anastomoses. Br. J. Surg., 70: 36-39.
2. Nisanevich, V., I. Felsenstein, G. Almogy, C. Weissman, S. Einav and I. Matot, 2005. Effect of intraoperative fluid management on outcome after intraabdominal surgery. Anesthesiology, 103: 25-32.
3. Lopes, M.R., M.A. Oliveira, V.O.S. Pereira, I.P.B. Lemos, J.O.C. Auler and F. Michard, 2007. Goal-directed fluid management based on pulse pressure variation monitoring during high-risk surgery: A pilot randomized controlled trial. Crit. Care, Vol. 11 .10.1186/cc6117.
4. Forget, P., F. Lois and M. de Kock, 2010. Goal-directed fluid management based on the pulse oximeter–derived pleth variability index reduces lactate levels and improves fluid management. Anesthesia Analg., 111: 910-914.
5. Futier, E., E. Robin, M. Jabaudon, R. Guerin and A. Petit *et al*., 2010. Central venous o2 saturation and venous-to-arterial CO_2 difference as complementary tools for goal-directed therapy during high-risk surgery. Crit. Care, Vol. 14. 10.1186/cc9310.
6. Strunden, M.S., K. Heckel, A.E. Goetz and D.A. Reuter, 2011. Perioperative fluid and volume management: Physiological basis, tools and strategies. Ann. Intensive Care, Vol. 1. 10.1186/2110-5820-1-2.
7. Zhang, J., H. Qiao, Z. He, Y. Wang, X. Che and W. Liang, 2012. Intraoperative fluid management in open gastrointestinal surgery: Goal-directed versus restrictive. Clinics, 67: 1149-1155.
8. Kulemann, B., S. Timme, G. Seifert, P.A. Holzner and T. Glatz *et al*., 2013. Intraoperative crystalloid overload leads to substantial inflammatory infiltration of intestinal anastomoses: A histomorphological analysis. Surgery, 154: 596-603.
9. Chawla, L.S., C. Ince, D. Chappell, T.J. Gan, J.A. Kellum, M. Mythen and A.D. Shaw, 2014. Vascular content, tone, integrity and haemodynamics for guiding fluid therapy: A conceptual approach. Br. J. Anaesth., 113: 748-755.
10. Pearse, R.M., D.A. Harrison, N. MacDonald, M.A. Gillies and M. Blunt *et al*., 2014. Effect of a perioperative, cardiac output–guided hemodynamic therapy algorithm on outcomes following major gastrointestinal surgery. JAMA, 311: 2181-2190.
11. Schmid, S., B. Kapfer, M. Heim, R. Bogdanski, A. Anetsberger, M. Blobner and B. Jungwirth, 2016. Algorithm-guided goal-directed haemodynamic therapy does not improve renal function after major abdominal surgery compared to good standard clinical care: A prospective randomised trial. Crit. Care, Vol. 20. 10.1186/s13054-016-1237-1.
12. Eng, O.S., S. Dumitra, M. O'Leary, M. Raoof and M. Wakabayashi *et al*., 2017. Association of fluid administration with morbidity in cytoreductive surgery with hyperthermic intraperitoneal chemotherapy. JAMA Surg., 152: 1156-1160.
13. Sun, Y., F. Chai, C. Pan, J.L. Romeiser and T.J. Gan, 2017. Effect of perioperative goal-directed hemodynamic therapy on postoperative recovery following major abdominal surgery: A systematic review and meta-analysis of randomized controlled trials. Crit. Care, Vol. 21. 10.1186/s13054-017-1728-8.

14. Carmichael, J.C., D.S. Keller, G. Baldini, L. Bordeianou and E. Weiss *et al*., 2017. Clinical practice guidelines for enhanced recovery after colon and rectal surgery from the American society of colon and rectal surgeons and society of American gastrointestinal and endoscopic surgeons. Dis. Colon Rectum, 60: 761-784.
15. Shin, C.H., D.R. Long, D. McLean, S.D. Grabitz and K. Ladha *et al*., 2018. Effects of intraoperative fluid management on postoperative outcomes. Ann. Surg., 267: 1084-1092.
16. Calvo-Vecino, J.M., J. Ripollés-Melchor, M.G. Mythen, R. Casans-Francés and A. Balik *et al*., 2018. Effect of goal-directed haemodynamic therapy on postoperative complications in low-moderate risk surgical patients: A multicentre randomised controlled trial (fedora trial). Br. J. Anaesth., 120: 734-744.