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Original research

Goal-directed fluid therapy in major elective rectal surgery

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HIGHLIGHTS

- This study investigates the role of Goal-directed fluid therapy (GDFT) specifically in major rectal resection.
- Patients undergoing GDFT receive greater volumes of colloid intraoperatively.
- There is no improvement in clinical outcomes in patients receiving GDFT.

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ABSTRACT

Introduction: Goal-Directed Fluid Therapy (GDFT) has been previously shown to decrease complications and hospital length of stay in major colorectal surgery but the data are not specific to rectal surgery and may be potentially outdated. This study investigated whether GDFT provides clinical benefits in patients undergoing major elective rectal surgery. **Methods**: There were 81 consecutive patients in this cohort study. Twenty-seven patients were allotted to GDFT using the Oesophageal Doppler Monitor (ODM) and received boluses of colloid fluid based on corrected flow time and stroke volume. These patients were compared with a historical cohort of the previous 54 patients managed without the ODM. The primary endpoint of the study was 30-day total complications which were defined and graded. Secondary endpoints included hospital length of stay (LOS) and fluid volumes administered. **Results**: There were no differences at baseline between the two groups. Patients in the treatment group received a higher volume of colloid fluids (1000 mL vs. 500 mL; $p < 0.01$) but there were no differences in overall fluid volumes administered intraoperatively (3000 mL vs. 3000 mL; $p = 0.41$). A non-significant trend ($p = 0.06$) suggested that patients allotted to GDFT had decreased fluid requirement in the first 24 h after surgery. There were no differences in median total fluid volumes (12700 mL vs. 10407 mL; $p = 0.95$), total complications (22 [81%] vs. 44 [81%]; $p = 1.00$) or median hospital LOS (9 days vs. 10 days; $p = 0.92$) between the two groups. **Conclusion**: Intraoperative GDFT did not improve clinical outcomes following major elective rectal surgery.

1. Introduction

In the setting of major colorectal surgery, intravenous fluid is administered based on either fixed-volume regimens or in an individualised manner based on markers of fluid-responsiveness using additional monitoring such as the Oesophageal Doppler Monitor (ODM) [1–3]. The latter is known as Goal-directed fluid therapy (GDFT) and is being increasingly adopted into practice [4]. GDFT has been recommended for routine use in major abdominal surgery in the United Kingdom and has been adopted as 'best practice' by the National Health Service [4]. It is also funded for use by the Medicare and Medicaid systems in the USA [5,6]. It has been shown to decrease total complications and hospital length of stay with valid scientific reasoning to explain the benefits of perioperative fluid optimisation [7,8].

Some of the published studies are specific to colorectal surgery whilst others have been conducted in patients undergoing a variety of major abdominal surgical procedures [9–11]. However, most of the colorectal-specific studies have not made a distinction between colon and rectal surgery even though these operations have been shown to be physiologically distinct from one another [12].

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Moreover, rectal surgery is often accompanied by the additional metabolic burden of stoma creation. This may also influence postoperative fluid requirements [13]. Important shortcomings of the evidence base governing goal-directed fluid therapy in major colorectal surgery have also been previously described and as a result, further procedure-specific studies have been thought to be necessary [13,14]. Thus, we conducted a study to examine the influence of goal-directed fluid therapy on clinical outcomes-with total complications as the primary focus-after elective rectal surgery.

2. Methods

2.1. Study design

Following regional and institutional ethical approval, written informed consent was obtained from 27 consecutive patients undergoing major elective rectal surgery at our institution. These patients all received intraoperative GDFT as guided by ODM measurements and were compared to a historical cohort of the previous consecutive 54 patients for a total of 81 consecutive patients.

Rectal surgery was defined as any resection including a section of bowel within 15 cm of the anal verge. Exclusion criteria for the study were acute operations, multivisceral resections, patient refusal, severe bleeding diathesis, severe oesophageal disease, recent oesophageal surgery and moderate/severe aortic valve disease as assessed by transthoracic echocardiogram.

Baseline characteristics were noted. The primary outcome for the study was 30-day total complications and these were graded using the Clavien–Dindo classification and defined based on published criteria [15,16]. The secondary outcomes for the study were day to meet discharge criteria; hospital length of stay; administered fluid volumes in the preoperative; intraoperative and postoperative period and total intravenous fluid administered. The intraoperative period was defined as the time within which the patient was in the operating theatre with the preoperative and postoperative period being before and after respectively. Clinical outcomes for the treatment group were noted prospectively and at the conclusion of patient recruitment, all outcomes were verified by personnel blinded to patient allocation on an intention-to-treat basis.

2.2. Preoperative management

Patients received preoperative carbohydrate loading and patients receiving bowel preparation received one litre of crystalloid fluid prior to surgery (Plasmalyte, Baxter Healthcare, NSW, Australia). Use of bowel preparation was at the surgeon's discretion.

2.3. Intraoperative management

All aspects of surgical technique were left up to the consultant surgeon.

All patients received volatile general anaesthesia and thoracic epidural analgesia was used, unless contraindicated, and activated from the initiation of the case. A low dose vasopressor infusion was used with metaraminol as the most common pressor. Patients received invasive blood pressure monitoring at the discretion of the anaesthetist. Eight milligrams of intravenous dexamethasone were administered at induction [17,18].

All patients in the treatment group had continuous Oesophageal Doppler monitoring (Cardio Q, Pharmaco Inc, Auckland, NZ) and had a disposable oesophageal probe inserted for this purpose (DP-12, Pharmaco Inc, Auckland, NZ). Monitoring was discontinued at the end of the operation and the probe was removed prior to extubation in the operating room. The ODM probe was inserted and operated by a trained research assistant who had no input into any other aspects of perioperative care. All data were recorded over an average of ten cycles [19]. Intraoperative fluid administration was in conjunction with the anaesthetist and was guided by a previously used protocol relying on obtained measurements of corrected flow time and stroke volume as shown in Fig. 1 [9,10]. Weight-based boluses of hydroxyethyl starch colloid (Voluven, Fresenius Kabi, NSW, Australia) were administered as outlined in the protocol. Due to concern regarding renal toxicity, gelatin based colloids (Gelofusine, Baxter Health, Auckland, NZ) were permitted if volumes greater than two litres were required. Plasmalyte was used as the intraoperative crystalloid. Blood products were used if the haemoglobin was less than 80 g/L in an otherwise well patient or less than 100 g/L in a patient with documented cardiac disease. Patients in the control group were managed without the ODM and their fluid management was at the discretion of the anaesthetist without a formal protocol specifying the use of colloid or crystalloid.

2.4. Postoperative care

The principles of enhanced recovery care were followed though a formal protocol has not been established for rectal surgery within our institution. Patients were allowed to eat solid food from the evening of the operation. Oral fluid intake was also encouraged as well as early mobilisation. Caloric supplementation was also provided (Fortisip, Nutricia Inc, Auckland, New Zealand). Epidural analgesia was continued till 72 h postoperatively and urinary catheters were left in till this time. Simple oral analgesia was provided regularly with avoidance of opioid analgesia unless required for break-through pain. Non-steroidal analgesia was used from postoperative day two (20 mg Tenoxicam, Valeant Pharmaceuticals Ltd, Auckland, New Zealand).

All intravenous fluids were stopped upon the patient arriving at the ward and oral intake of food; fluids and supplements was encouraged. The patient was then formally assessed by the ward doctor to decide whether any intravenous fluid was necessary. Clinicians were required to see the patient and document their findings and were not allowed to make decisions over the phone. This judgement was based on patient observations, clinical examination and urine output. Examination findings consistent with volume deficit were required to prescribe intravenous fluid (e.g. decreased jugular venous pulse). Intravenous fluid was administered if patients were oliguric (defined as less than 0.5 mL/kg/h averaged over four hours) or had deranged physiological parameters suggestive of volume deficit (tachycardia (>90 bpm)), low blood pressure (systolic blood pressure < 90 mmHg in the presence of a functioning epidural; <100 mmHg without an epidural) Intravenous fluid was also administered for resuscitative purposes in the event of complications, to compensate for losses such as in high output stomae or for poor oral intake such as in paralytic ileus.

2.5. Discharge criteria

The following criteria had to be satisfied for patients to be eligible for discharge: Pain managed by oral analgesia alone; able to mobilise at least to and from the toilet; passage of flatus either per rectally or via stoma; able to tolerate solid foods; satisfactory capability to manage stoma as determined by the stoma therapist; normalising blood tests including C reactive protein; absence of complications.