
Intrathecal Analgesia and Restrictive Perioperative Fluid Management within Enhanced Recovery Pathway: Hemodynamic Implications

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BACKGROUND: Intrathecal analgesia and avoidance of perioperative fluid overload are key items within enhanced recovery pathways. Potential side effects include hypotension and renal dysfunction.

STUDY DESIGN: From January 2010 until May 2010, all patients undergoing colorectal surgery within enhanced recovery pathways were included in this retrospective cohort study and were analyzed by intrathecal analgesia (IT) vs none (noIT). Primary outcomes measures were systolic and diastolic blood pressure, mean arterial pressure, and heart rate for 48 hours after surgery. Renal function was assessed by urine output and creatinine values.

RESULTS: One hundred and sixty-three consecutive colorectal patients (127 IT and 36 noIT) were included in the analysis. Both patient groups showed low blood pressure values within the first 4 to 12 hours and a steady increase thereafter before return to baseline values after about 24 hours. Systolic and diastolic blood pressure and mean arterial pressure were significantly lower until 16 hours after surgery in patients having IT compared with the noIT group. Low urine output (<0.5 mL/kg/h) was reported in 11% vs 29% (IT vs noIT; $p = 0.010$) intraoperatively, 20% vs 11% ($p = 0.387$), 33% vs 22% ($p = 0.304$), and 31% vs 21% ($p = 0.478$) for postanesthesia care unit and postoperative days 1 and 2, respectively. Only 3 of 127 (2.4%) IT and 1 of 36 (2.8%) noIT patients had a transitory creatinine increase >50%; no patients required dialysis.

CONCLUSIONS: Postoperative hypotension affects approximately 10% of patients within an enhanced recovery pathway and is slightly more pronounced in patients with IT. Hemodynamic depression persists for <20 hours after surgery; it has no measurable negative impact and therefore cannot justify detrimental postoperative fluid overload. (*J Am Coll Surg* 2013; 216:1124–1134. © 2013 by the American College of Surgeons)

Enhanced recovery pathways (ERPs) successfully reduce complications, hospital stay, and costs in colorectal surgery and are considered standards of care in many centers.¹⁻⁵ Two of the key principles of ERPs are the

avoidance of perioperative fluid overload and minimization of systemic opioid consumption.^{4,6-9}

Optimal perioperative fluid management within an ERP aims to maintain homeostasis and has become more restrictive than traditional fluid management.^{4,6,9-13} Modern protocols propagate a zero fluid balance.¹⁴ Traditional fluid management by contrast aims to maintain blood pressure (BP) and heart rate (HR) by liberal administration of IV fluids to prevent the potential for hypovolemia-induced disturbance of microcirculation and organ dysfunction.^{12,15} Evidence for a more stringent fluid administration is compelling, as the results of this strategy lead to reduced cardiopulmonary complications and faster intestinal recovery without compromising wound healing.^{4,7,9,10,12,16-20}

Current European recommendations propagate mid-thoracic epidural analgesia (EDA) as the perioperative analgesic mainstay in ERP to limit use of systemic opioids

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Abbreviations and Acronyms

BP	= blood pressure
EDA	= epidural analgesia
ERP	= enhanced recovery pathway
HR	= heart rate
IQR	= interquartile range
IT	= intrathecal analgesia
MAP	= mean arterial pressure
noIT	= no intrathecal analgesia
PACU	= postanesthesia care unit
POD	= postoperative day

and, specifically, their related side effects.⁹ The beneficial effects of EDA on pain reduction, intestinal recovery, and pulmonary morbidity have been widely acknowledged.²¹⁻²⁹ Potential side effects of EDA include transient arterial hypotension in about 10% of patients, pruritus, and urinary complications.^{24,28-31} In addition, EDA requires postoperative follow-up and specialized nursing care, making it work- and cost-intensive. In addition, the patient is bound to an additional device, which can impede early ambulation. Recent studies have suggested that, in the setting of ERP, single-injection intrathecal analgesia (IT) can provide equivalent analgesia compared with EDA, but with earlier return of bowel function, earlier mobility, and shorter hospital length of stay after elective laparoscopic colorectal surgery.³²⁻³⁵

Balanced fluid management, with the goal of euvoletic state, and neuraxial blockade both have the potential to induce arterial hypotension and hypoperfusion-induced organ dysfunction, such as renal insufficiency, myocardial ischemia, and impaired wound healing.^{12,15} Episodic hypotension, whether the result of IT or fluid restriction, can result in excess fluid administration with the intention to “correct” a perceived “hypovolemic state.”

The objective of this retrospective cohort study is to test the hypothesis that the combination of balanced IV fluid management in conjunction with IT adversely affects perioperative hemodynamics and renal function.

METHODS

After obtaining Mayo Clinic Institutional Review Board approval, all consecutive patients undergoing elective open and minimally invasive colorectal procedures within a standardized ERP at Mayo Clinic, Rochester between January 2010 and May 2010 were identified. Patients that failed to provide research authorization were excluded. Patients with IT were compared with patients without (noIT). All data were collected from electronic medical records and the Colorectal Surgery Division Database with prospectively defined variables and were continuously maintained by research staff unaware of the study hypothesis.

Enhanced recovery pathway

This institution's ERP was implemented in November 2009 and initial results have been described in detail previously.⁵ Briefly, pain management includes preoperative treatment with celecoxib and gabapentin, intraoperative IT, and scheduled acetaminophen and nonsteroidal anti-inflammatory medications postoperatively. In addition, oral oxycodone was available postoperatively as needed for reported numeric pain intensity score rating >4. Intraoperative fluid guidelines were set, with laparoscopic operative patients to receive 5 mL/kg/h or up to 500 mL/h and open procedural patients to receive 8 mL/kg/h (up to 800 mL/h). Intraoperative fluid administration consisted of lactated Ringer's solution and an additional 500 mL of 5% albumin if the anesthetist believed it to be necessary on evaluation of intravascular status. Postoperative IV fluids were, by default, dextrose 5% and 0.45% sodium chloride with 20 mEq/L potassium chloride. Postoperative maintenance rate of 40 mL/h was to be continued until the morning after surgery (POD1) at 8 AM. Intraoperatively, all patients underwent general endotracheal anesthesia with an inhaled anesthetic in air/oxygen. All patients received postoperative nausea and vomiting prophylaxis consisting of dexamethasone and a 5HT-3 antagonist plus droperidol for patients at highest risk based on institutional postoperative nausea and vomiting consensus guidelines. The nasogastric tube was removed at the end of the procedure and oral intake (eg, fluids, oral nutritional supplements, regular diet) was started 4 hours after surgery. Patients were assisted by dedicated nursing staff to be mobilized 2 hours on the day of surgery and 8 hours per day on the following days. The urinary catheter was removed the day after surgery at 8 AM. Discharge criteria include adequate pain control, oral intake, and return to baseline mobility. Resumption of bowel movement was not a compulsory requirement for discharge.

Intrathecal analgesia

As part of the ERP, patients were consented for single-injection IT placed under sterile conditions immediately before induction of general anesthesia. Patients in whom neuraxial regional anesthesia was contraindicated (eg, patients with coagulopathy or pre-existing neurologic dysfunction) or who refused regional anesthesia were given IV systemic opiates intraoperatively. The IT injection consisted of preservative-free hydromorphone (0.05 to 0.08 mg) with intrathecal bupivacaine or clonidine adjuncts given at the discretion of the attending anesthesiologist. Administration of additional systemic opiates intraoperatively and in the postanesthesia care unit (PACU) was at the discretion of the attending anesthesiologist.

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