

June 8, 2016

Clinical Guidance Note 3

British Columbia Enhanced Recovery Collaborative Guidance on Goal-Directed Fluid Therapy

Optimal management of perioperative fluid therapy remains a highly debated topic. The purpose of optimal fluid management is to maintain (or restore) effective circulating blood volume during the perioperative period with the goal of maintaining effective blood volume and blood pressure to assure adequate organ perfusion while avoiding the risks associated with either organ hypo- or hyper perfusion (1). There is wide variability of practice, both between individuals and institutions (2). Intravenous fluids should be administered with the same rigour as with any other drug (3).

The published literature comparing goal directed fluid therapy versus “conventional” therapy needs to be reviewed with caution, as there have been many variations in protocols over time regarding the volume and type of fluid administered and whether it was done in the context of a full Enhanced Recovery program(4). Fluid management within Enhanced Recovery should be viewed as a continuum through the preoperative, intraoperative, and postoperative phases. Each phase is important for improving patient outcomes, and suboptimal care in one phase can undermine best practice within the rest of the Enhanced Recovery pathway (5).

This Guidance Note aims to support appropriate fluid therapy protocols. The Enhanced Recovery Collaborative recommends that *appropriate* fluid therapy be applied for all elective colorectal patients, and *goal-directed* fluid therapy be applied for select patients. The Enhanced Recovery Collaborative supports the following evidence-based practices with respect to goal-directed fluid therapy for elective colorectal surgery.

Guidance Note 3 was developed by the Anesthesia Community of Practice of the BC Enhanced Recovery Collaborative (“the Collaborative”). It has been reviewed by the multi-disciplinary members of the Collaborative, presented to the BC Anesthesiologists Society for feedback, and approved by the Collaborative’s clinical co-chairs.

This document is not intended to serve as a comprehensive review of the literature, or a statistically driven guidelines document. The Anesthesia Community of Practice undertook an extensive review of current literature and practice patterns for goal-directed fluid therapy, assessed the practical implications of the various proposed algorithms, and sought to summarize evidence and advise British Columbia’s clinicians as to best practice based on current evidence. In the end, each site and practitioner should base decisions on providing patient care, including utilizing goal-directed fluid therapy, based on consultation with local care providers, and through a multidisciplinary collaborative approach.

Which patients? Which procedures?

A review of the literature around patient selection criteria for goal-directed fluid therapy tends to be overly inclusive. The Enhanced Recovery Collaborative supports the following criteria to select patients who could benefit most from the use of special monitoring techniques:

1. *Use a monitor for high risk surgery, which is defined as:*
 - Open or high risk to open, or;
 - Expected surgical duration of more than 3.5 hours. (The 3-4 hour threshold is based on currently available evidence from studies on plastic surgery procedures, such as free flaps (6), spine surgery (7), and general surgery (8).)
2. *Use a monitor for the high risk patient (9), defined as:*
 - ASA Physical Status 3 or more, or;
 - Expected Blood Loss >500ml, or;
 - Extremes in BMI, or;
 - Age \geq 80 years.

Pre-Op Fluids

The following practices help the patient attain euvolemia upon admission to hospital:

- Follow modern fasting guidelines, particularly with respect to the patient's pre-operative intake oral fluids including a complex carbohydrate-loading beverage
- Avoid mechanical bowel preparation, if possible; use a low impact bowel preparation, if necessary. Please refer to the Enhanced Recovery Collaborative's Guidance Note 1 on Mechanical Bowel Preparation.

Perioperative Fluid Management Guidelines

- Consider using a controlled infusion device including intraoperatively
- Use a balanced salt solution, such as plasmalyte, Ringers Lactate, or Normosol
- Aim for baseline infusions \leq 2ml/kg/hr perioperatively (based on ideal body weight)(1)
- Assess volume status early perioperatively: particularly prior to surgical incision and/or creation of pneumoperitoneum.
- If there is clinical indication that patient is hypovolemic give boluses given 3ml/kg based on ideal body weight. There is no clear evidence comparing colloids versus crystalloids (10) and choice should be left to individual practitioner.
- When not using monitors, it is expected that the average goal of total fluids would be in the range of 4-8 ml/kg/hr based on anesthetic time. Current Enhanced Recovery in NSQIP (ERIN) guidelines had suggested <8ml/kg/hr, which was not based on any clear studies. Concern was raised at the last ERIN Collaborative meeting that <4ml/kg/hr may be too restrictive (see below regarding restrictive regimens). The goal is zero-balance fluid therapy with the aim of maintaining central euvolemia while minimizing salt and water (11).

Current “restrictive” fluid regimens that have been published (12) or that are recruiting (13) patients generally defined their regimens as follows:

“At induction of anesthesia, limit IV bolus fluid to ≤ 5 ml/kg; no other IV fluids will be used at the commencement of surgery (unless indicated by goal-directed device). Balanced crystalloid solutions at 5 ml/kg/h will be administered until the end of surgery, and bolus colloid/blood used intraoperatively to replace blood loss (ml for ml)”.

Tools

The Enhanced Recovery Collaborative informally surveyed anesthesiologists from 13 hospitals to assess BC’s experience with monitors to date. There are many competing technologies and all have limitations. Some common challenges in using various monitors include: difficulty in positioning the probe, particularly when the patient is repositioned frequently, signal blockages due to cautery artifact, and time and volume of cases needed to become proficient in using the monitors. Despite the challenges of using monitors, the Collaborative believes that the technology can be a valuable tool for monitoring trends, and that it can provide complementary data to that provided via an arterial line and other devices, and that it can enable the clinician to make better-informed decisions.

There are two main categories of monitors to consider:

- 1) invasive monitors that measure stroke volume variation or pulse pressure variation
- 2) non-invasive monitors such as esophageal dopplers

Regardless of monitors which optimally require higher ventilator volumes, all patients should in general be receiving mechanical tidal volumes of < 8 ml/kg.

Goal-directed fluid therapy should be driven by optimizing cardiac output and not just stroke volume. To achieve this appropriate inotropic and vasopressor support may be required. Using pulse pressure variation (PPV) techniques, a “grey” zone of 9-13% exists where fluid response is not a reliable prediction of volume responsiveness. When assessing PPV, SPV, PVI, and using tidal volumes of < 8 ml/kg/hr, a response of $> 13\%$ is a more reliable threshold to guide fluid administration.

Post-Operative Fluids

In the post-operative setting, oral rehydration, rather than via the IV route should be the priority. However, pre-existing kidney pathology can influence outcomes and should also be assessed in determining the best process of care.

Low urine output, typically defined as 20ml/hour, in isolation is not an indication for fluid bolus administration. If urine output remains low after 4 hours post-operatively, the patient should be evaluated and examined for evidence of hypovolemia: routine telephone orders for fluid boluses should be discouraged.

- Use balanced salt solution for bolus
- D5/0.45 NS for basal fluid management
- Lock IV by POD 1 (or TKVO if on PCA)

- Encourage early oral fluids (recognizing that oral fluids in PACU may not be practical for all sites and may cause problems with a mixed patient base in PACU.)

Operational Considerations

- Fluid balance, as well as fluid parameters and trends that are being monitored, should be consistently entered into the patient's chart. The conversion of colloid to crystalloid is 1:1.5. For NSQIP sites, data collection processes should consider concordance with Enhanced Recovery In NSQIP (ERIN) data definitions.
- The Enhanced Recovery Collaborative encourages a team-approach to determining and enabling appropriate fluid therapy for each patient.
- To facilitate implementation, the processes of care described above should be integrated into pre-printed order sets and the training of staff, including medical office assistants for pre-operative patient education and the postgraduate resident trainee staff for perioperative/postoperative management.

References

- (1) Navarro LHC, Bloomstome JA, Auler, JOC et al. Perioperative Fluid Therapy: a statement from the international Fluid Optimization Group. *Perioperative Medicine* 2015;4:3-23
- (2) Lilot M et al. Variability in practice and factors predictive of total crystalloid administration during abdominal surgery: retrospective two-centre analysis. *Br J Anaesth.* 2015;114:767-76
- (3) Minto G & Mythen MG. Perioperative fluid management: science, art or random chaos. *Br J Anaesthesia.* 2015;114:717-21
- (4) Rollins, KE, Lobo DN. Intraoperative Goal Directed Fluid Therapy in Elective Major Abdominal Surgery. A Meta-analysis of Randomized Controlled Trials. *Annals of Surgery* 2015 published ahead of print
- (5) Miller TE, et al. Fluid management and goal-directed therapy as an adjunct to Enhanced Recovery After Surgery (ERAS). *Can J Anesth.* 2015;62: 158-168
- (6) Hardy KL, Davis KE, Constantine RS, et al. The Impact of Operative Time on Complications After Plastic Surgery: A Multivariate Regression Analysis of 1753 Cases. *Aesthetic Surgery Journal* 2014;34(4) 614-22.
- (7) Kim BD, Hsu WK, De Oliveira GS, et al. Operative Duration as an Independent Risk Factor for Postoperative Complications in Single-Level Lumbar Fusion: An Analysis of 4588 Surgical Cases. *Spine* 2014;39: 510-520.
- (8) Proctor LD, Davenport DL, Bernard AC, et al. General Surgical Operative Duration Is Associated with Increased Risk-Adjusted Infectious Complication Rates and Length of Hospital Stay. *J Am Coll Surg* 2010;210(1)60-5.
- (9) Cecconi M, Corredor C, Arulkumaran N, et al. Clinical Review: Goal-directed therapy—what is the evidence in surgical patients? The effect on different risk groups. *Critical Care* 2013;17:209.
- (10) Yates DRA et al. Crystalloid or colloid for goal-directed fluid therapy in colorectal surgery. *Br J Anaesth* 2014;112:281-9.
- (11) Brandstrup B et al. Which goal for fluid therapy during colorectal surgery is followed by the best outcomes: near-maximal stroke volume or zero fluid balance? *Br J Anaesth* 2012; 109:191-9
- (12) Phan TD, D'Souza B, Rattray MJ et al. A Randomized controlled trial of fluid restriction compared to oesophageal Doppler-guided goal-directed fluid therapy in elective major colorectal surgery within an Enhanced Recovery After Surgery program. *Anaesth Intensive Care* 2014;42:752-60.

(13) REstrictive Versus LIberal Fluid Therapy in Major Abdominal Surgery: RELIEF Study.
Paul S Myles. Recruiting until November 2017.

Appendix 1: About the BC Enhanced Recovery Collaborative

From November 2014 to January 2016, eleven BC surgical sites worked together as the BC Enhanced Recovery Collaborative ('the Collaborative'). The Collaborative aimed to improve outcomes for elective colorectal surgery patients by collectively implementing the evidence-based Enhanced Recovery protocol: a multi-modal perioperative care pathway designed to achieve early recovery after surgical procedures by maintaining pre-operative organ function and reducing the profound stress response following surgery. Sponsored by the Specialist Services Committee (SSC), the BC Enhanced Recovery Collaborative applied the Institute for Healthcare Improvement Breakthrough Series model to integrate evidence into practice by promoting cross-site learning and teaching, efficient sharing of resources and tools, and development of a multi-disciplinary network of Enhanced Recovery clinicians and champions.

For more information on the BC Enhanced Recovery Collaborative, please refer to the detailed [Final Report](#) and Final Report – [Highlights](#), which describe the background, structure, activities, results, and lessons learned from the Collaborative experience.

Specialist Services Committee (Sponsor)

- Dr. Ron Carere, SSC, Co-Chair
- Dr. Sean Virani, SSC, Co-Chair
- Adrian Leung, SSC, Executive Lead
- Angie Chan, SSC, Project Manager, Surgical Improvement
- Elizabeth Babcock, SSC, Assistant

Participating Collaborative Sites

- Campbell River Hospital
- Kelowna General Hospital
- Langley Memorial Hospital
- Mills Memorial Hospital (Terrace)
- Mount St. Joseph's Hospital (Vancouver)
- Nanaimo Regional General Hospital
- Royal Columbian Hospital (New Westminster)
- Royal Inland Hospital (Kamloops)
- St. Paul's Hospital (Vancouver)
- Surrey Memorial Hospital
- Vancouver General Hospital

Participating Health Authorities

- Fraser Health Authority
- Interior Health Authority
- Island Health Authority
- Northern Health Authority
- Providence Health Care
- Vancouver Coastal Health Authority

Advisory Panel

- Dr. Ron Collins, Enhanced Recovery Collaborative Anesthesia Co-Chair, Interior Health
- Dr. Ahmer Karimuddin, Enhanced Recovery Collaborative Surgery Co-Chair, Providence Health Care
- Garth Vatkin, Enhanced Recovery Collaborative Nursing Co-Chair, Interior Health
- Andrea Bisailon, Vancouver Coastal Health
- Dr. Jean Lauzon, Fraser Health
- Dr. Willem Lombard, Northern Health
- Valerie MacDonald, BC Hip Fracture Initiative
- Kimberly McKinley, BC Patient Safety & Quality Council
- Dr. Samaad Malik, Island Health
- Dr. Kelly Mayson, Vancouver Coastal Health
- Dr. Richard Merchant, Fraser Health
- Dr. Jill Osborn, Providence Health Care
- Stephen Parker, Providence Health Care
- Brenda Poulton, Fraser Health
- Geoff Schierbeck, BC Patient Safety & Quality Council
- Dr. Jacques Smit, Island Health
- Dr. Tom Wallace, Interior Health
- Dr. Garth Warnock, Vancouver Coastal Health
- James Watson, Island Health
- Deborah Bachand, Island Health (former member)
- Ly Truong, Island Health (former member)

Anesthesia Community of Practice

Anesthesia

- Dr. Ron Collins, Kelowna General Hospital
- Dr. Pal Dhadly, Univ. Hospital of Northern BC
- Dr. David Hadid, Mills Memorial Hospital
- Dr. Maha Iyer, Surrey Memorial Hospital
- Dr. Bruce Kilpatrick, Royal Inland Hospital
- Dr. Magda Lipowska, Lion's Gate Hospital
- Dr. Mark Masterson, Kelowna General Hospital
- Dr. Kelly Mayson, Vancouver General Hospital
- Dr. Andrew Meikle, Vancouver General Hospital
- Dr. Richard Merchant, Royal Columbian Hospital
- Dr. Clare Morrison, Lion's Gate Hospital
- Dr. Michael Negraeff, Vancouver General Hospital
- Dr. Scott Neilson, Nanaimo Regional General Hospital
- Dr. Jill Osborn, St. Paul's Hospital
- Dr. Sarah Pearce, Campbell River Hospital
- Dr. Steve Petrar, St. Paul's Hospital
- Dr. Chris Pollitt, Campbell River Hospital
- Dr. Curt Smecher, Abbotsford Regional Hospital
- Dr. Jacques Smit, Royal Jubilee Hospital
- Dr. Cornel Van West, Richmond Hospital
- Dr. Annika Vrana, Lion's Gate Hospital
- Dr. Cynthia Yarnold, St. Paul's Hospital

Nursing/Quality Improvement

- Jan Muir, Providence Health Care
- Stephen Parker, Providence Health Care
- Karen Phenix, Nanaimo Regional General Hospital
- Brenda Poulton, Royal Columbian Hospital
- Garth Vatkin, Kelowna General Hospital

Surgery

- Dr. Ahmer Karimuddin, St. Paul's Hospital
- Dr. Jean Lauzon, Peace Arch Hospital
- Dr. William Lombard, Mills Memorial Hospital

Pharmacy

- Asal Taheri, Providence Health Care

Patient Partners

- Lavina Boyd
- Pamela Jessen

Partner Organization

- BC Patient Safety & Quality Council