



Administrative Office:

600 University Ave, 449
Toronto, ON
M5G 1X5
T: 416.586.4800 x8534
F: 416.586.8644
E: epearsall@mtsinai.on.ca
W: www.bpigs.ca

Steering Committee

Robin McLeod, Chair
Mount Sinai Hospital

Mary-Anne Aarts
Toronto East General
Hospital

Lesley Gotlib
St. Michael's Hospital

Marg McKenzie
Mount Sinai Hospital

Allan Okrainec
Toronto Western Hospital

Emily Pearsall
Mount Sinai Hospital

Naveed Siddiqui
Mount Sinai Hospital

Enhanced Recovery after Surgery Guideline

MA Aarts, A Okrainec, T Wood, EA Pearsall, and RS McLeod

A Quality Initiative of the Best Practice in General Surgery Part of CAHO's ARTIC program

Section 1: General Information
Process
Rationale

Section 2: Protocol Recommendations

Section 3: Evidentiary Base

Section 4: External Review Process



Section 1. General Information about this Guideline

Aim

The aim of this guideline is to make recommendations for pre-, intra- and post-operative interventions which will optimize perioperative recovery for elective colorectal patients at the adult University of Toronto affiliated teaching hospitals.

Outcomes of Interest

The outcomes of interest are decreased complications, enhanced patient recovery, decreased length of stay and increased patient satisfaction.

Target Population

These recommendations apply to adult patients undergoing elective colorectal surgery.

Intended Users

This guideline is intended for use by general and colorectal surgeons and residents who perform elective colorectal surgery as well as other health care providers including anaesthetists, nurses, dietitian and physiotherapists involved in the management and care of these patients.

Overview of Process

A review of existing guidelines for Enhanced Recovery after Surgery, or Fast Track Surgery was conducted to obtain a comprehensive list of all interventions used in established guidelines. We then conducted a systematic review of each individual ERAS intervention to assess the supporting evidence. We held a multidisciplinary consensus meeting with representation from members of the perioperative teams at the adult University of Toronto affiliated hospitals responsible for the management of elective colorectal surgical patients. Once consensus was reached on which interventions should be included in the University of Toronto ERAS Guideline, sub-groups were created to further review the evidence and make specific recommendations. Where evidence was weak-to-moderate, expert consensus and current practice were used to make recommendations.

Acknowledgements

We would like to thank those who participated in the consensus workshop as well as the members of the sub-groups who provided their time and expertise to the development of this guideline. As well, we would like to extend a special thanks to members of the Best Practice in General Surgery Steering Committee for their guidance. Lastly, we are grateful to each hospital affiliated with the University of Toronto for their financial assistance and overall support for the development and implementation of this guideline.

Section 2. Summary of Guideline Recommendations

The following recommendations are based on a systematic review of existing ERAS guidelines, a systematic review of each of the individual interventions, as well as expert consensus.

1. Preoperative Care

1.1 Preoperative Information and Counseling

All patients should be made aware of what they can anticipate in the perioperative period as well as what is expected of them in their recovery process

- 1.1.1 For patients who do not have postoperative complications and have no other co-morbidities or issues which would affect length of stay, the target for the duration of stay for those having colon operations is 3 days and for rectal operations (anastomosis below the peritoneal reflection) is 4 days
- 1.1.2 Patients should receive information on approximate length of stay; preoperative fasting and carbohydrate loading; pain control; early ambulation; postoperative feeding/ileus; time of catheter removal; and gum chewing
- 1.1.3 Patients should also receive information on smoking cessation
- 1.1.4 Patients and their families should receive oral information, as well as the patient education booklet
- 1.1.5 The booklet should be given to patients in the surgeon's office. The surgeon should inform the patient to bring the booklet with them every time they come to the hospital, including their preoperative appointment and the day of their surgery
- 1.1.6 Nurses in the Pre-Admission Unit as well as on the Surgical Floor should be familiar with the booklet to assist the patients in answering any questions
- 1.1.7 Patients should be instructed to bring 2 packages of gum to the hospital

1.2 Reduced Fasting Duration

For patients who are undergoing elective colorectal surgery and a significant delay in gastric emptying is not suspected

- 1.2.1 Patients should be allowed to eat solid foods until 12 midnight and clear liquids until 2 to 3 hours before surgery or until they leave for the hospital (Level of evidence: High)
- 1.2.2 Patients should be encouraged to drink a suitable carbohydrate rich drink, up to 800 mL at bedtime the night before surgery and 400 mL until 2 to 3 hours before surgery or until they leave for the hospital (Level of evidence: Moderate-Low)

1.3 Mechanical Bowel Preparation (refer to BPIGS Guideline #2 at www.bpiqs.ca)

These recommendations include the following:

- 1.3.1 Patients having an open or laparoscopic colorectal procedure except LAR ± diverting stoma (but including segmental resections, APR, TPC, IPAA, etc) do not require MBP, should have no dietary restrictions and should have a Fleet enema if they are having a left sided anastomosis (Level of evidence: High)

- 1.3.2 Patients having an open or laparoscopic low anterior resection (LAR) with or without a diverting stoma should take a MBP, should not have any dietary restrictions prior to taking the MBP and then afterwards should stay on clear liquids and should take a Fleet enema (Level of evidence: Moderate)

2. Intraoperative Care

2.1 *Surgical Site Infection Prevention (refer to BPIGS Guideline #1 at www.bpiqs.ca)*

2.2 *Thromboprophylaxis (refer to BPIGS Guideline # 3 at www.bpiqs.ca)*

2.3 Intraoperative Fluid Management

- 2.3.1. Intraoperative fluid management should be goal directed based on the available parameters. These parameters include but not limited to: electrocardiogram, heart rate, blood pressure, and urine output. In some circumstance where monitors to measure cardiac output and stroke volume are available, fluid therapy should be titrated to optimize cardiac performance or stroke volume (Level of evidence: Moderate-High)
- 2.3.2. Perioperative hemodynamics should be considered relative to baseline values rather than absolute values that need to be maintained. Allowable changes in hemodynamics should be individualized to each patient, but changes in heart rate and blood pressure of < 20% from baseline is most often acceptable (Level of evidence: Moderate-High)
- 2.3.3. When hypovolemia is suspected, a fluid challenge of either crystalloid or colloid (200 – 250 ml) should be tested. The response should be reassessed using the available hemodynamic parameters. The fluid challenge may be repeated based on a positive response e.g. a 10% increase in stroke volume or an increase in blood pressure. Clinical response to fluid challenge may be monitored by change in heart rate, measurement/estimation of the pulse pressure variation, and blood pressure before and after receiving the fluid challenge. Fluid challenge should be repeated until there is no further increase in stroke volume and/or improvement in the clinical parameters (Level of evidence: Moderate-Low)
- 2.3.4. Intraoperative crystalloid administration should consist of a balanced salt solution (either Ringer's Lactate or Plasmalyte) (Level of evidence: Moderate-Low)
- 2.3.5. The rate of intraoperative fluid for maintenance should not be more than 1-2 ml/kg/hr. The use of an infusion pump may be considered to reduce the risk of fluid overload (Level of evidence: Low)
- 2.3.6. The administration of fluid for purposes other than optimization of the intravascular fluid volume should be avoided. For example, the administration of crystalloid as a carrier for drug administration can be reduced by using an injection port as close to the patient as possible to avoid the need to flush in drugs with large amounts of crystalloid (Level of evidence: Moderate-Low)
- 2.3.7. For patients who have had a mechanical bowel preparation, this fluid deficit could be replaced using crystalloid up to 500ml. Response to fluid challenge should be considered in determining the dose of crystalloids (Level of evidence: Low)

- 2.3.8. Crystalloid can be used to replace minor blood loss. Acute blood loss during surgery can be replaced with crystalloids or colloids. Colloids should be considered for situations requiring a rapid replacement of intravascular volume (Level of evidence: Moderate-Low)
- 2.3.9. Acute blood loss during the surgery can be replaced with the use of colloids on a ratio of 1:1 (Level of evidence: Moderate-Low)
- 2.3.10. Use of normal saline should be reserved for patients who are hyponatremic or hypochloremic (for example, those where there is drainage of large volumes of gastric fluid or pre-existing derangements from diuretic use) (Level of evidence: Moderate-Low)

2.4 Avoidance of Prophylactic Abdominal Drains

- 2.4.1. The use of prophylactic abdominal drains should be avoided following elective colorectal surgery (Level of evidence: High)
- 2.4.2. Prophylactic drains may be used following abdominoperineal resection (Based on consensus only)

2.5 Avoidance of Prophylactic Nasogastric Tubes

Prophylactic use of nasogastric tubes for decompression should be avoided. (Level of evidence: High)

3. Postoperative Care

3.1 Early Mobilization

Patients who undergo elective colorectal surgery should be encouraged to participate in early mobilization

- 3.1.1 Patients should dangle their legs on the day of surgery
- 3.1.2 Patients should eat all of their meals in a chair
- 3.1.3 Patients should ambulate every 4 to 6 hours each day while they are awake until discharge (Level of evidence: Moderate)

3.2 Postoperative Fluid Management

- 3.2.1. Patients who do not have adequate oral intake should receive not more than 75 mL/hr of 2/3-1/3 with 20 mEq potassium/day, or a similar rate using a balanced salt solution if electrolyte replacement is required. The routine use of saline is to be discouraged (Level of evidence: Moderate-Low)
- 3.2.2. Postoperatively, volume status should be assessed before fluid boluses are given. Boluses should not be given because of low urine output or low blood pressure alone. Instead, the blood pressure, heart rate, urine output and mental status of patients should all be considered. In addition, the preoperative blood pressure should be considered when making decisions about the postoperative volume status (Level of evidence: Moderate-Low)

3.3 Early Enteral Feeding

- 3.3.1. Patients should be offered sips of clear fluid 2 hours postoperatively provided they are awake, alert and capable of swallowing (Level of evidence: Moderate-Low)
- 3.3.2. Patient controlled diet should be encouraged: patients should be offered a regular diet beginning postoperative day 1 and patients should be allowed to decide what and how much they want to consume each day (Level of evidence: Moderate)
- 3.3.3. Patients should be encouraged to bring dry food from home

3.4 Use of Chewing Gum to Reduce Postoperative Ileus

The use of chewing gum should be encouraged starting on postoperative day 1. Each patient should chew one stick of gum, for at least 5 minutes, ≥ 3 times per day (Level of evidence: Moderate-High)

3.5 Optimal Duration of Urinary Drainage

- 3.5.1 All patients undergoing surgery with a low colorectal anastomosis or coloanal anastomosis (≤ 6 cm the anal verge) should have their urinary catheter removed within 72 hours after the surgery (Level of evidence: High)
- 3.5.2 For patients undergoing some colon resections, it may be appropriate to not insert a urinary catheter. If patients do require a urinary catheter it should be removed within 24 hours after the surgery (Level of evidence: High)
- 3.5.3 The above recommendations apply to patients with or without an epidural catheter at the time of removal (Level of evidence: Moderate-High)
- 3.5.4 The above recommendations do not apply if a catheter is needed for monitoring purposes (Level of evidence: Moderate-Low)

3.6 Perioperative Pain Management (refer to BPIGS Guideline # 6)

Section 3. Recommendations and Key Evidence

Enhanced Recovery after Surgery refers to multimodal programs which have been developed to decrease postoperative complications, accelerate recovery and promote early discharge. Interventions included in ERAS programs include best practices aimed at decreasing perioperative stress, postoperative pain, gut dysfunction and infection, and promoting early mobilization. To date, there have been 8 published randomized controlled trials evaluating ERAS programs for patients undergoing elective colorectal surgery. A meta-analysis of these trials, which included 452 patients who had elective colorectal surgery, found that there was a 2.5 days (95% CI, 3.92-1.11) decrease in length of stay and a 50% decrease in 30 day morbidity (RR 0.52, CI, 0.36-0.73)¹.

While overall these programs have been shown to be effective, the interventions included in these different programs as well as in ERAS guidelines vary. Thus, as part of the guideline process, the Best Practice in General Surgery group reviewed all of the trials and guidelines to identify individual interventions and then reviewed the evidence for each intervention. The individual interventions considered were the following:

- Preoperative counselling
- Preoperative probiotics
- Preoperative carbohydrate loading
- Preoperative fasting
- Perioperative NSAIDS
- Intraoperative and postoperative fluid management
- Surgical incision
- Epidurals
- Intraoperative and postoperative IV lidocane
- Use of nasogastric tubes
- Use of drains
- Postoperative promotilities
- Postoperative laxatives
- Clear fluids/early feeding
- Early ambulation
- Duration of Foley Catheter
- Postoperative liquid calorie supplements
- Gum chewing
- Postoperative nausea and vomiting prevention

Following this, a systematic review of all randomized controlled trials and meta-analyses (including Cochrane Reviews) was performed. Then, a panel of nurses, dieticians, physiotherapists and general surgeons and anaesthetists from 8 University of Toronto hospitals (Mount Sinai Hospital, North York General Hospital, St. Michael's Hospital, St. Joseph's Health Center, Sunnybrook Health Sciences Center, Toronto East General Hospital, and University Health Network) met in May 2011. At this meeting, the evidence for each intervention was

reviewed and the group came to consensus on which individual interventions should be included in the University of Toronto Enhanced Recovery after Surgery Guideline. The major considerations in selecting interventions were the strength of evidence, feasibility and acceptability of adopting the interventions. Thus, 10 interventions are included. Management of postoperative pain is an important component of an ERAS guideline. A separate guideline is being developed in conjunction with this clinical practice guideline (*refer to BPIGS Guideline #6*). While there is strong evidence supporting the use of intravenous lidocaine postoperatively, it was felt that there would be barriers to its adoption. For carbohydrate loading, probiotics and motility agents, the supporting evidence was not strong. Some interventions are included in BPIGS guidelines already (surgical site infection prevention, thromboprophylaxis, normothermia, mechanical bowel preparation). Finally, we chose, at this time, not to develop standard anaesthetic and post operative nausea and vomiting prevention protocols.

Once there was consensus about which interventions should be included in the guideline, three subgroups were formed: Preoperative Counselling, Early Mobilization and Feeding Group; Surgery Group and Anaesthesia Group. These groups reviewed the evidence of the assigned interventions and made specific recommendations for each of the interventions. The recommendations for each intervention and the supporting evidence are reviewed below:

1. Preoperative Care

1.1 Preoperative Information and Counseling

All patients should be made aware of what they can anticipate in the perioperative period as well as what is expected of them in their recovery process

- 1.1.1 For patients who do not have postoperative complications and have no other co-morbidities or issues which would affect length of stay, the target for the duration of stay for those having colon operations is 3 days and for rectal operations (anastomosis below the peritoneal reflection) is 4 days**
- 1.1.2 Patients should receive information on approximate length of stay; preoperative fasting and carbohydrate loading; pain control; early ambulation; postoperative feeding/ileus; time of catheter removal; and gum chewing**
- 1.1.3 Patients should also receive information on smoking cessation**
- 1.1.4 Patients and their families should receive oral information, as well as the patient education booklet**
- 1.1.5 The booklet should be given to patients in the surgeon's office. The surgeon should inform the patient to bring the booklet with them every time they come to the hospital, including their preoperative appointment and the day of their surgery**
- 1.1.6 Nurses in the Pre-Admission Unit as well as on the Surgical Floor should be familiar with the booklet to assist the patients in answering any questions**
- 1.1.7 Patients should be instructed to bring 2 packages of gum to the hospital**

Summary of Evidence

Preoperative patient education is an essential component of ERAS programs. Appropriate preoperative education has been shown to decrease patients' anxiety and fears about surgery, reduce postoperative complications, as well as lessens the use of postoperative analgesia while promoting shorter hospital stays²⁻⁵. Many patients view surgery as a threatening experience with many stressful components which elicit strong emotional responses^{4,5}. These responses including fear, distress, and anxiety, can have negative repercussions for the patient in the postoperative period (3,4). Research, although limited, has shown that preoperative psychosocial interventions have positive effects on postoperative psychological and physical functioning⁴⁻⁶. Additionally, it was suggested that patient education should address the patient, the patient's spouse or partner, and the patient-partner relationship⁴.

Providing patients with preoperative information has become the standard of care as it is well known that preoperative information, in any form, produces favorable results⁶. Two meta-analyses conducted on the effects of patient education preoperatively did not provide recommendations on the most favorable form of information, but rather recommended that patients receive information about their surgery preoperatively^{5,6}.

One meta-analysis conducted by Devine in 1992 included 191 studies and organized the interventions by three distinct content domains: health care relevant information, exercises to perform (skills teaching), and psychological support⁵. Healthcare relevant information includes things that should be done prior to surgery, timing of various procedures, as well as the functions and roles of various health care providers⁵. Skills teaching relate to breathing exercises and exercises to do while in bed⁵. Lastly, psychological support includes identifying the concerns of individual patients and attempting to alleviate these concerns, providing appropriate reassurances, and encouraging the patient to ask questions at any time during the process (4). This study found that the method of delivery for patient education was variable and included interventions such as booklets, audiovisual materials⁵. In some instances patients were taught in groups or individually, however most interventions were only given once⁵. The delivery was most often provided by a nurse, and ranged from 7 to 90 minutes (median 30)⁵. Patients were most often provided with information the night prior to surgery.

The second meta-analysis was conducted in 1986 included 68 studies and expanded on Devine's first meta-analysis conducted in 1983 (above is the updated version of that meta-analysis)⁶. This meta-analysis differs in the breadth of outcomes examined as well as in the interventions identified⁶. This analysis categorized the data by way of different content including procedural, sensory, and psychological as well as combinations of the three. Procedural content includes information regarding the patients physical care regime that is presented in a factual, concrete, reality-based way⁶. Sensory content includes information that describes how the patient might see, feel, taste, or smell postoperatively⁶. Physiological content aimed at understanding the patients' attitudes and feelings (5). This study found that most information is provided by a nurse and that nurses should be more aware of the patients' level of fear and anxiety⁶.

Both meta-analysis concluded the patient education interventions should include all of the domains they discussed so that patients' stress and anxiety levels will decrease^{5,6}. As well, they concluded that preoperative instruction has a positive effect on postoperative outcomes regardless of the small magnitude and consistency of benefits^{5,6}.

There appears to be various barriers to the implementation of a patient education program. Mullen et al. suggest that the practice of delivery is not systematic and that nurses opinions limit the amount of information patients receive⁷. As well, health care professionals are often uncertain who bears the responsibility for educating the patients⁸. Health care professionals feel that scheduling constraints, lack of time to train new staff, as well as change in practice are often cited by nurses as inhibiting their ability to adopt a new patient education program⁸.

Thus, the above recommendations largely stem from the literature on ERAS protocols and current practice^{2,3}. The ERAS Group suggests that providing patients with clear expectations of what will occur during hospitalization leads increased adherence to the guideline and allows for early recovery and discharge^{2,8,9}. Additionally, patients should be given clear tasks including milestones for such interventions as food intake and mobilization^{2,3,9,10}.

1.2 Reduced Fasting Duration

For patients who are undergoing elective colorectal surgery and a significant delay in gastric emptying is not suspected

1.2.1 Patients should be allowed to eat solid foods until 12 midnight and clear liquids until 2 to 3 hours before surgery or until they leave for the hospital (Level of evidence: High)

1.2.2 Patients should be encouraged to drink a suitable carbohydrate rich drink, up to 800 mL at bedtime the night before surgery and 400 mL until 2 to 3 hours before surgery or until they leave for the hospital (Level of evidence: Moderate-Low)

Summary of Evidence

Early research in the area of fasting determined that for passive regurgitation and pulmonary aspiration to occur during anaesthesia, a certain gastric volume must be present. It has been assumed that a minimum of 200 mL of residual volume is required for regurgitation.^{11,12} Numerous studies have reported a preoperative mean gastric fluid volume in the range of 10-30 mL, with 120 mL rarely exceeded irrespective of intake of clear fluids.^{13,14} With this in mind, many trials have attempted to confirm this principle. The Cochrane review¹⁵ has provided the most thorough compilation of work and has served as justification for many of the modern day fasting guidelines. Their review included 22 individual randomized controlled trials with a total of 2270 participants. Their results can be summarized into 4 separate goals:

- a) Optimum duration of fast for fluids: none of the trials that were included noted an occurrence of aspiration or regurgitation in any of the investigational groups. Individual trials examined gastric content by investigating gastric residual volume and pH as surrogate markers. They compared a standard fast with a fast that allowed some fluid

intake up to 90min, between 120-180min and up to 180min preoperatively. The trials that allowed fluid intake grouped the volume of allowed fluid intake into either 150 mL or between 300-450 mL. They noted no difference in gastric content between any of the groups compared to the gastric volume of the standard. In addition, there was no difference in pH values between those having a standard fast or a shortened fast. In regards to thirst, all groups that received fluids recorded a reduction in thirst and dryness of mouth; however, postoperatively there was no difference in thirst between the groups. There was no significant difference in regards to preoperative hunger, nausea, or vomiting between any of the groups.

- b) Optimum duration of fast for solids: the only available data that was reviewed on shortened solid fast compared to a standard fast were trials that were conducted in 1983. The participants randomized to the treatment group received a small preoperative breakfast (mean of 249 minutes and 199 minutes prior to induction). In both trials there was no difference between the groups in regards to gastric residual volume or gastric pH values. These trials had a very small sample size, as such, very little can be concluded from their results.
- c) Volume of Fluids: the review classified volume into low (≤ 150), high (>150), and unlimited. The investigators did not report any incidence of aspiration or regurgitation. They did not find a difference in gastric content volume or pH in any of the treatment groups or in the standard fast group. They did note that participants who either received a low volume of fluid or a high volume of fluid reported a decrease in thirst in the preoperative period but not in the postoperative period. In addition, the trials that allowed unlimited fluids preoperatively had significantly less thirst both preoperatively and postoperatively
- d) Type of permitted liquid: the review included trials that compared water to the standard fast, coffee to the standard fast, and water, orange juice, apple juice, carbohydrate drink, coffee or tea to the standard fast. The trials that examined only water found a statistically significantly lower volume of intraoperative gastric contents in the participants permitted preoperative water ($p=0.02$); however, this difference was not considered clinically significant. In regards to the other 2 interventions, there was no difference in the volume of gastric contents between the treatment and the standard fasting groups.

Ideally patients should come to surgery in a metabolically fed state, rather than starving and ketotic. A carbohydrate load given preoperatively may lead to reduced insulin resistance, decreased stress response to surgery, earlier return of bowel function and shortened length of stay. The consumption of carbohydrate enriched drinks, 800 mL at bedtime the night before surgery and 400 ml 2-3 hours before surgery has been shown to be safe and reduces preoperative thirst, hunger, anxiety and postoperative insulin resistance. There is little evidence that carbohydrate loading results in improvement of other surgical outcomes^{16,17}.

There is very little evidence available that allows an evidence based recommendation for solid intake. The current guideline of 6 hours is based on the estimated physiologic gastric emptying time for healthy patients. An ultrasonographic study by Soreide et al.¹⁸ showed that 4 hours of fasting was required to guarantee complete emptying of solid particles after a light breakfast. In addition, factors such as smoking, functional dyspepsia, psychological stress and female hormones may further prolong gastric emptying times for solids.^{19,20} Combining this set of information, and allowing a sufficient margin of safety, it was recommended that the fasting period after intake of solids should not be less than 6 hours.²¹⁻²³

In summary, the evidence that favours reducing fasting times appears to be sufficient and is supported by numerous world wide guidelines. Reducing the fasting time to 2 hours for clear fluids and 6 hours for solids does not increase the risk of regurgitation or pulmonary complications in patients who are otherwise healthy. As such, adopting these practices should become the standard of care.

1.3 Mechanical Bowel Preparation (refer to BPIGS Guideline #2 at www.bpigs.ca)

These recommendations include the following:

- 1.3.1 Patients having an open or laparoscopic colorectal procedure except LAR ± diverting stoma (but including segmental resections, APR, TPC, IPAA, etc) do not require MBP, should have no dietary restrictions and should have a Fleet enema if they are having a left sided anastomosis (Level of evidence: High)**
- 1.3.2 Patients having an open or laparoscopic low anterior resection (LAR) with or without a diverting stoma should take a MBP, should not have any dietary restrictions prior to taking the MBP and then afterwards should stay on clear liquids and should take a Fleet enema (Level of evidence: High)**

2. Intraoperative Care

2.1 Surgical Site Infection Prevention (refer to BPIGS Guideline #1 at www.bpigs.ca)

2.2 Thromboprophylaxis (refer to BPIGS Guideline # 3 at www.bpigs.ca)

2.3 Intraoperative Fluid Management

- 2.3.1. Intraoperative fluid management should be goal directed based on the available parameters. These parameters include but not limited to: electrocardiogram, heart rate, blood pressure, and urine output. In some circumstance where monitors to measure cardiac output and stroke volume are available, fluid therapy should be titrated to optimize cardiac performance or stroke volume (Level of evidence: Moderate-High)**
- 2.3.2. Perioperative hemodynamics should be considered relative to baseline values rather than absolute values that need to be maintained. Allowable changes in hemodynamics should be individualized to each patient, but changes in heart rate and**

- blood pressure of < 20% from baseline is most often acceptable (Level of evidence: Moderate-High)
- 2.3.3. When hypovolemia is suspected, a fluid challenge of either crystalloid or colloid (200 – 250 ml) should be tested. The response should be reassessed using the available hemodynamic parameters. The fluid challenge may be repeated based on a positive response e.g. a 10% increase in stroke volume or an increase in blood pressure. Clinical response to fluid challenge may be monitored by change in heart rate, measurement/estimation of the pulse pressure variation, and blood pressure before and after receiving the fluid challenge. Fluid challenge should be repeated until there is no further increase in stroke volume and/or improvement in the clinical parameters (Level of evidence: Moderate-Low)
 - 2.3.4. Intraoperative crystalloid administration should consist of a balanced salt solution (either Ringer's Lactate or Plasmalyte) (Level of evidence: Moderate-Low)
 - 2.3.5. The rate of intraoperative fluid for maintenance should not be more than 1-2 ml/kg/hr. The use of an infusion pump may be considered to reduce the risk of fluid overload (Level of evidence: Low)
 - 2.3.6. The administration of fluid for purposes other than optimization of the intravascular fluid volume should be avoided. For example, the administration of crystalloid as a carrier for drug administration can be reduced by using an injection port as close to the patient as possible to avoid the need to flush in drugs with large amounts of crystalloid (Level of evidence: Moderate-Low)
 - 2.3.7. For patients who have had a mechanical bowel preparation, this fluid deficit could be replaced using crystalloid up to 500ml. Response to fluid challenge should be considered in determining the dose of crystalloids (Level of evidence: Low)
 - 2.3.8. Crystalloid can be used to replace minor blood loss. Acute blood loss during surgery can be replaced with crystalloids or colloids. Colloids should be considered for situations requiring a rapid replacement of intravascular volume (Level of evidence: Moderate-Low)
 - 2.3.9. Acute blood loss during the surgery can be replaced with the use of colloids on a ratio of 1:1 (Level of evidence: Moderate-Low)
 - 2.3.10. Use of normal saline should be reserved for patients who are hyponatremic or hypochloremic (for example, those where there is drainage of large volumes of gastric fluid or pre-existing derangements from diuretic use) (Level of evidence: Moderate-Low)

Summary of Evidence

Fluid administration is an important consideration in the care of almost all patients undergoing surgical procedures. Perioperative fluid therapy has come under scrutiny in recent years because several studies have demonstrated that fluid therapy may influence the post operative outcome. Hypovolemia must be avoided because it may lead to adverse events ranging from minor organ dysfunction to multiorgan failure and death. Conversely, liberal administration of fluid may impair pulmonary, cardiac and gastrointestinal function and lead to post operative complications and prolonged recovery. Further complicating this discussion is

the variability among studies with regards to definitions of restricted or liberal fluid management²⁴.

Bundgaard-Nielsen et al²⁴ performed a meta-analysis of 7 randomized controlled trials comparing two different fixed fluid volumes on post operative clinical outcomes following major surgery. Five trials included only patients having elective colorectal surgery, one included patients having arthroplasty and one included patients having major abdominal surgery. In the seven trials, liberal intraoperative fluid regimens ranged from mean 2750 to mean 5388 cc compared with mean 998 to mean 2740 cc in the restrictive groups. The period for fluid restriction and outcome endpoints were inconsistent leading to the authors concluding that “liberal vs restrictive fixed volume regimens are not well defined in the literature regarding the definition, methodology and results thereby precluding evidence based guidelines for procedure-specific perioperative fixed-volume regimens”. However, the authors suggest optimization of perioperative fluid management using a combination of crystalloids to replace extravascular volume and individualized goal-directed colloid administration to maintain a maximal stroke volume.

There are 5 trials which include patients having elective colorectal surgery only. They too vary in what a restricted vs a liberal protocol meant. Some compared intra and postoperative fluid protocols²⁵⁻²⁷ while two compared restricted vs liberal postoperative fluid protocols^{28,29}. Many appeared to be quite strict and therefore are work intensive and may decrease the feasibility of adopting the protocol. The sample sizes of the trials were quite small ranging from 20 to 151 patients. Lastly, the outcome measures tended to be postoperative complications, time to flatus and time to discharge but were not consistently reported in all trials.

Two trials^{25,28} showed earlier return of GI function and decreased hospital stay²⁸ or decreased complication rates²⁵. Two others showed no advantage to a restricted fluid regimen^{27,29} and one showed an increase in morbidity with fluid restriction²⁶.

In order to minimize the confusion with different terminologies, Rahbari et al performed a meta-analysis of standard, restrictive, and supplemental fluid administration in colorectal surgery³⁰. They first standardized the definitions of terms: standard, restrictive, and supplemental fluid administration for patients undergoing bowel surgery. Six RCTs investigated the amount of fluid and 3 trials investigated goal-directed therapy by means of Esophageal Doppler derived variables. All were of moderate-to-high quality. The trial by Holte et al, was reclassified as standard and supplemental instead of restrictive versus standard based on the amount of fluids given²⁶. The primary end point of this meta-analysis was overall postoperative morbidity. The restrictive fluid administration strategy decreased overall postoperative morbidity [odds ratio 0.45, confidence interval (CI): 0.28-0.72, P<0.001]. If the intraoperative period was not included in the study, this benefit was not seen. There was no significant reduction in mortality and anastomotic leakage.

All trials used some form of invasive or minimally invasive measure to record different

indices of cardiac output. The most commonly used modality for this purpose was an Esophageal Doppler^{31,32}. Esophageal Doppler guided goal directed therapy in patients undergoing elective colorectal resection used a fluid algorithm of repeated colloid boluses until there was no increase in stroke volume at least by 10%. The postoperative morbidity was significantly reduced in goal directed therapy patients (odds ratio 0.43, CI: 0.26-0.71, P=0.001). No other benefit could be elucidated in patients intervened by goal directed therapy.

The type of fluids to be given in the perioperative period is as controversial as the amount of fluids³³. Crystalloid versus colloid therapy is as controversial as which type of crystalloid or colloid to be given. Grocott et al and Boldt, reviewed the different types of fluids and their influences on outcome^{33,34}. Six percent Hydroxyethyl starch (HES) has been well studied for the colloid crystalloid comparisons. It is important to note that the crystalloids leave the intravascular compartment earlier and more than the colloids, and therefore a larger volume is necessary to replenish volume deficits (3 to 4 times of the volume of crystalloids). This leads to increased tissue edema. The association of tissue edema with compromise in perfusion and oxygenation is controversial^{35,36}. Large amounts of saline lead to hyperchloremic acidosis³⁷. All semi synthetic colloids can affect coagulation due to either hemodilution or colloid specific effects. Gelatin seems to have the lowest degree of effect on coagulation. A combination of colloids and crystalloids such as balanced salt solution titrated to a dynamic fluid loading parameter seems to be a good strategy in this current situation.

One particularly significant consideration in evaluating a patient's fluid loss prior to surgery is whether the patient had a mechanical bowel preparation (MBP)³⁸. Several studies have shown that some bowel preps may cause preoperative fluid loss in patients undergoing major colorectal surgery. These studies suggest that hypertonic bowel preps (e.g., sodium phosphate) in healthy volunteers may result in dehydration, and increases in plasma osmolality³⁹. Based on these alterations, some authors suggest that low levels of crystalloid replacement (<500 mL) may improve subjective sensations such as thirst, whereas large volumes of replacement (2 L) improve postoperative symptoms such as dizziness and nausea. At present there is ample evidence to demonstrate that the use of bowel preparation leads to adverse outcomes⁴⁰. Hence its use is mostly discouraged. However in patients where bowel prep has been used it is prudent to assume that some of these patients are depleted of at least 500 mL of fluid upon entering the operating room.

2.4 Avoidance of Prophylactic Abdominal Drains

2.4.1. The use of prophylactic abdominal drains should be avoided following elective colorectal surgery (Level of evidence: High)

2.4.2. Prophylactic drains may be used following abdominoperineal resection (Based on consensus only)

Summary of Evidence

The use of prophylactic drains in colorectal patients has been extensively studied. A Cochrane Review from 2004⁴¹ included 6 randomized controlled trials with 1140 patients from

studies that included cancer, bowel inflammatory disease and non-inflammatory disease. Their data showed no statistical difference in regards to mortality (3% in the drain group compared to 4%), clinical anastomotic dehiscence (2% in the drain group compared to 1%), radiological anastomotic dehiscence (3% in the drain group compared to 4%), wound infection (5% in both groups), and reintervention (6% in the drain group compared to 5%). In regards to reoperation, special attention was drawn to anastomotic complications. As there was not a significant difference, the authors inferred that drains did not play the role of preventing dissemination to peritoneal cavity, when anastomotic dehiscence occurs. A systematic review by Petrowsky et al⁴² confirmed the findings from the Cochrane review and although no statistical significance was noted, there was a slight advantage for non-drained patients for clinical leakage (OR=1.38, CI=0.77-2.49) and wound infections (OR=1.41, CI=0.87-2.29). In addition, Urbach et al showed that in only 1 of 20 clinical leakages pus or feces emerged through the drain, indicating that drains have a low sensitivity (5%) to detect clinical leakage.⁴³

In summary, use of a prophylactic drain in colorectal surgery is not supported by the available literature. There is no evidence that such a drain will prevent anastomotic dehiscence or allow for early detection of clinical leakage. Furthermore, the use of a drain may actually increase the incidence of both wound infections and clinical leakage.

2.5 Avoidance of Prophylactic Nasogastric Tubes

Prophylactic use of nasogastric tubes for decompression should be avoided. (Level of evidence: High)

Summary of Evidence

The Cochrane Collaboration originally published a review article titled “Prophylactic nasogastric decompression after abdominal surgery” in 2004, which has subsequently undergone two additional updates in 2007 and 2010.⁴⁴ The review examined randomized controlled trials that compared individuals with and without routine prophylactic use of NG tube gastric decompression. The population consisted of adults over the age of 18 who had any type of abdominal operation. Included in this review were colorectal, gastroduodenal, biliary, esophageal, and hepatic surgeries. Furthermore, the results from each individual trial were in agreement with the conclusions of the Cochrane review. The review examined 5 major outcomes, including:

- a) Time to Flatus: of the studies analyzed, it was shown that there is no benefit to NG suction in accelerating the return of gastrointestinal function as measured by time to flatus. Specifically, amongst the patients having colon surgery there was an earlier return of bowel function seen in patients without a tube.
- b) Pulmonary Complications (pneumonia and atelectasis): non-routine NG suction conferred a benefit (OR=1.45, CI=1.10-1.92). A subgroup analysis was done and found no difference in outcome amongst those who had colon surgery and a lower rate of

complications amongst those who had upper gastrointestinal surgery and did not receive a NG tube (OR=1.49, CI=1.01-2.21)

- c) Wound Infection & Anastomotic leak: all studies that reported wound infections and/or anastomotic leak failed to show a difference between the groups
- d) Length of Stay: the majority of the studies reported a lower mean length of stay for the group without a tube, although statistical significance was not reached (OR=0.53, CI=0.39-1.46)
- e) Gastric Upset: a total of 25 studies reported vomiting in the postoperative period of which the majority of trials showed more vomiting in the group without the tube (OR=0.64, CI=0.46-0.90)

A recent study by Kerger et al⁴⁵ assessed the incidence of postoperative vomiting amongst those who did or did not receive an NG tube. The findings of this comparative study showed that intraoperative use of an NG tube was not associated with a reduction in nausea (OR=1.23, p=0.14), vomiting (OR=0.92, p=0.64), or postoperative nausea and vomiting (OR=1.22, p=0.16). The 24 hour postoperative nausea and vomiting incidence was 44.4% in patients with an intraoperative NG tube and 41.5% amongst those without a NG tube.⁴⁵

In summary, the evidence indicates that the original rationale for using prophylactic NG intubation, such as a reduction in wound infections, anastomotic leak, shorter length of stay, and pulmonary complications (pneumonia, atelectasis), are no longer valid reasons to use such therapy. As such, its use should be avoided as a prophylactic measure after abdominal surgery.

3. Postoperative Care

3.1 Early Mobilization

Patients who undergo elective colorectal surgery should be encouraged to participate in early mobilization

3.1.1 Patients should dangle their legs on the day of surgery

3.1.2 Patients should eat all of their meals in a chair

3.1.3 Patients should ambulate every 4 to 6 hours each day while they are awake until discharge (Level of evidence: Moderate)

Summary of Evidence

Early ambulation is often combined with other strategies in a multi-modal approach. As such, the evidence presented must be taking in context along with the other modalities used. Khoo et al⁴⁶ stated that individually the intervention modalities appear to improve outcome, but the degree of improvement is not usually marked; however, in combination the improvements to the rate of recovery appear to be strong and very robust. The first trial to evaluate the use of ambulation in context of a multimodal approach was completed by

Bardram et al⁴⁷ The study looked at 9 consecutive patients who were undergoing elective colonic resection. Patients received a thoracic epidural catheter, normal oral food intake was allowed immediately after surgery, and they were out of bed for a median of 6 hours on the 1st day and 8 hours on the 2nd day. Of the 9 patients, 6 patients went home on postoperative day (POD) 2 and at 1 month postoperative all the patients had returned to their baseline function. A recent study by Lee et al.⁴⁸ looked at the effect a rehabilitation program with early mobilization and diet has on recovery rate. They randomized 100 patients, who had received laparoscopic colon surgery, into a rehabilitation group with early mobilization and diet or to a conventional care group. They measured recovery time by including: 1) tolerance of diet for 24 hours (eat 1/3rd or more of their meal), 2) analgesic free, 3) safe ambulation (ambulation 600 m without assistance), 4) afebrile status without major complications. They found that a rehabilitation program resulted in improved recovery after laparoscopic colon surgery (median (interquartile range), 4(3-5) days in the rehabilitation group compared to 6 (5-7) days, $p < 0.0001$) with no adverse effect on pain scores, complications, quality of life, or readmission. The observed improvements in recovery variables (diet tolerance, ambulation, and absence of pain and major complications) were strong in the rehabilitation group. Henriksen et al conducted a study that randomized 40 patients undergoing elective colorectal surgery to receive enforced mobilization, balanced anesthesia, and postoperative analgesia (including epidural anesthetic) or anesthesia without an epidural, postoperative analgesia with epidural morphine, and mobilization without fixed goals. All the patients included in the study were offered early oral nutrition. The authors published 2 separate papers with two different outcomes based on their multi-modal approach. The first paper⁴⁹ examined the effect this multi-modal approach had on ambulation time and on muscle function. The study found that mobilization was much more efficient in the intervention group than in control group, starting on POD 1. Ambulation time in hours and activity as measured by number of steps walked were both statistically significant ($p < 0.01$) and the activity correlated significantly to the ambulation time (< 0.0001). The median cumulated ambulation times for POD 1-5 in the intervention group was 27.7 hours (5.5 hour/day) compared to 8.3 hours (1.7 hours/day, $p < 0.01$). In addition, the authors did not find a significant difference in the rate of fatigue between the groups or pain scores. Furthermore, the voluntary strength of the quadriceps muscle decreased by 3% in the intervention group versus 15% in the control group on day 7 ($p = 0.04$) and this difference remained the same 2 months postoperatively ($p = 0.02$). The second paper⁵⁰ examined the effect that this same multi-modal approach had on overall nutrition intake. The mean (SE) daily energy intakes during the recovery period were 73 (8) kJ/kg in the intervention group and 52 (7) kJ/kg in the control group ($p = 0.04$). The mean (SE) protein intakes during the same period were 0.95 (0.1) g/kg/day in the intervention group and 0.57 (0.06) g/kg/day in the control group ($p < 0.01$). In addition, when comparing to the patients baseline, they found that a loss of body weight, lean body mass, and fat mass was significant in the control group after 7 days; however, this was not the case in the intervention group. As such, the authors concluded that early mobilization likely contributes to both a reduction in muscle loss and an increase in overall nutrition intake.

There have been considerable amounts of literature that support the use of a laparoscopic surgical approach as part of the enhanced recovery protocol. As such, Lin et al⁵¹

aimed to investigate whether a laparoscopic approach allows earlier ambulation and if this subsequently results in better patient outcomes. This was a prospective study that examined 70 open colectomy patients and 99 laparoscopic-assisted colectomy patients. All patients were similarly encouraged to ambulate daily and the importance of ambulation was explained to each patient. They found that the average ambulation distance after open and laparoscopic colectomy on POD 1 were 67 and 390 feet, respectively ($p < 0.001$), 290 and 752 feet on POD 2 ($p < 0.001$), and 495 and 965 feet on day 3 ($p < 0.001$). Furthermore, they found that the average length of stay in the open group was 9.3 days compared with 5.9 days in the laparoscopic group ($p < 0.001$). The authors concluded that the improvement in length of stay was likely a result of both a laparoscopic approach and earlier ambulation. Furthermore, they stated that based on the potential benefits of early ambulation, including a reduction in VTE and its associated sequelae, laparoscopic surgery should be the preferred approach in order to acquire the benefits of early ambulation.

The final study⁵² was a novel approach to identify if early mobilization has an effect on the duration of a postoperative ileus (POI). The rationale for this study was that back and forth motion of a rocking chair may reduce intestinal gas accumulation, abdominal distention, and pain associated with POI in abdominal surgery. This study adds to the current body of literature due to the fact that part of the early mobilization initiative is to get the patient out of bed and into a chair as soon as possible. A total of 66 patients, who underwent abdominal surgery for gastrointestinal cancers, were evaluated. The control and intervention groups received the same care, with the exception of the type of early mobilization. The control group's mobilization included walking and sitting up out of bed in a non-rocking chair beginning on POD 1, whereas the intervention group received care that included walking and rocking in a rocking chair beginning on POD 1. The authors found that the rocking group passed flatus on average 0.7 days (16.8 hours) earlier than the non-rocking group and that on average the non-rocking experienced a significantly longer time to passage of first flatus ($p = 0.001$). In addition, there was a trend towards a greater amount of pain medication received in the non-rocking group as compared with the rocking group; however, this was not significant. Finally, time to discharge, total laps ambulated, and total amount of time spent in the chair was equivalent amongst the two groups. Although this study needs to be replicated in a large scale fashion before any recommendations can be made, it emphasizes the importance of not only early mobilization but also the potential benefits of specific types of mobilization.

In summary, the role of early mobilization after surgery likely provides multiple postoperative benefits, including a reduction in VTEs and an earlier removal of a bladder catheter. Its effect on overall recovery must be taking in context with the other modalities that it is commonly combined with. Furthermore, combining early mobilization with early enteral feeding and balanced anesthesia, along with a laparoscopic approach, appears to provide a synergistic benefit to the patient and is slowly being adopted amongst enhanced recovery programs around the world.

3.2 Postoperative Fluid Management

- 3.2.3. Patients who do not have adequate oral intake should receive not more than 75 mL/hr of 2/3-1/3 with 20 mEq potassium/day, or a similar rate using a balanced salt solution if electrolyte replacement is required. The routine use of saline is to be discouraged (Level of evidence: Moderate-Low)**
- 3.2.4. Postoperatively, volume status should be assessed before fluid boluses are given. Boluses should not be given because of low urine output or low blood pressure alone. Instead, the blood pressure, heart rate, urine output and mental status of patients should all be considered. In addition, the preoperative blood pressure should be considered when making decisions about the postoperative volume status (Level of evidence: Moderate-Low)**

Summary of Evidence

Please refer to section 2.3 Intraoperative Fluid Management

3.3 Early Enteral Feeding

- 3.3.1. Patients should be offered sips of clear fluid 2 hours postoperatively provided they are awake, alert and capable of swallowing (Level of evidence: Moderate-Low)**
- 3.3.2. Patient controlled diet should be encouraged: patients should be offered a regular diet beginning postoperative day 1 and patients should be allowed to decide what and how much they want to consume each day (Level of evidence: Moderate)**
- 3.3.3. Patients should be encouraged to bring dry food from home**

Summary of Evidence

The Cochrane Collaboration reviewed all the relevant randomized controlled trials regarding early enteral feeding up until August 2006.⁵³ They included colorectal surgery trials that compared early enteral feeding or supplemented oral feeding with no food (placebo) or a registered oral intake. Their goal was to determine if early EN following GI surgery is of clinical benefit. They reported on 7 different outcomes including: wound infection, intra-abdominal abscess, anastomotic dehiscence, post surgical pneumonia, mortality, length of stay, and adverse effects. The composite findings regarding wound infection (RR=0.77, CI=0.48-1.22), intra-abdominal abscess (RR=0.87, CI=0.31-2.42), anastomotic dehiscence (RR=0.69, CI=0.36-1.32), and post surgical pneumonia (RR=0.76, CI=0.36-1.58) failed to reach conventional levels of statistical significance but the direction of effect indicates a likely benefit. Evaluating mortality as an outcome resulted in a significant reduction (RR=0.41, CI=0.18-0.93) amongst the patients who were randomized to the early EN group. Although it was difficult to determine the relationship between early feeding and mortality reduction, the majority of deaths in the control population were secondary to conditions that could benefit from nutrition (cardiac dysfunction, anastomotic leak or sepsis). The length of stay displayed a tendency towards a shorter length of stay for the treatment group with an overall reduction that corresponded to approximately one day. In regards to adverse effects, there was a significant increase in the relative risk of vomiting amongst patients who were fed early (RR=1.27, CI=1.01-1.61, p=0.04).

Since the Cochrane review was released, several new trials have been published that add to this body of literature. A study by Han-Geurts et al⁵⁴ assessed the effects of an early oral diet on GI function and quality of life in patients undergoing elective open colorectal or abdominal vascular surgery. They found no difference between groups in regards to return of bowel function, postoperative complication rate, length of stay, and quality of life scores. They found that patients in the free diet group tolerated a diet containing solid foods a median of 2 days after surgery. Their study indicates that oral feeding is tolerated independent of the presence of a postoperative ileus. El Nakeeb et al⁵⁵ randomized patients to either an early feeding group that began fluids on the first postoperative day or to a regular feeding group that was managed as “nil per os” until the ileus resolved. They did not find a difference in wound complications, anastomotic leakage, or abnormalities in serum electrolytes. The majority of their patients tolerated early feeding (75%), with vomiting occurring more frequently in the early feed group (25% and 10%, p=0.05). The time to flatus was seen earlier in the early feeding group (3.3 +/- 0.9 compared to 4.2 +/- 1.2, p=0.04) and time to first defecation was sooner in the early feeding group (4.1 +/- 1.2 compared to 4.9 +/- 1.2, p=0.005). Postoperative stays for the early feed group was shorter (6.2 +/-0.2) compared to the traditional method (6.9+/-0.5, p=0.05).

In summary, the evidence indicates that the traditional method of “nil per os” until bowel function resumes does not provide optimal patient management. Early enteral feeding does not increase the rate of wound infection, infectious complications, or anastomosis dehiscence rather there is strong evidence to suggest that it may provide a protective effect. In addition, the majority of patients are able to tolerate early feeding even without the resolution of an ongoing ileus. Overall, patients who receive early enteral feeding consistently have a shorter length of stay.

3.4 Use of Chewing Gum to Reduce Postoperative Ileus

The use of chewing gum should be encouraged starting on postoperative day 1. Each patient should chew one stick of gum, for at least 5 minutes, ≥ 3 times per day (Level of evidence: Moderate-High)

Summary of Evidence

The first trial to evaluate the use of chewing gum following gastrointestinal surgery was completed by Asao et al⁵⁶ They found that in those who received chewing gum, the time to passage of first flatus and defecation was significantly shorter. Since this initial study, several randomized controlled trials have been published. Currently, 4 separate systematic reviews and meta-analysis that has been published on this subject. The first review was completed by Chan et al.⁵⁷ who included 5 trials from patients who underwent colorectal resection. In total, 158 patients were randomized to either standard care therapy or to receive the intervention. They found that all patients tolerated the gum without any side-effects. In regards to intestinal motility, they found that patients in the gum chewing group passed flatus 24.3% earlier (weighted mean difference of -20.8 hours, p=0.0006) and had a bowel movement 32.7% earlier (weighted mean difference of -33.3 hours, p=0.0002). The patients in the gum chewing group

were discharged 17.6% earlier (weighted mean difference of -2.4 days, $p < 0.00001$) and did not differ in regards to postoperative complication rates, and readmission or reoperation rates. Parnaby et al⁵⁸ conducted a similar review on 6 randomized controlled trials that contained a total of 256 patients. They found similar results in regards to a significant reduction in time to flatus and time to bowel movement; however, they did not note a significant reduction in length of stay. Interestingly, the authors urge the reader to use caution with the results as the studies included had different techniques for randomization, 5 trials lacked blinding, and no allocation concealment was completed. In addition, study heterogeneity existed secondary to differing colorectal pathology, operative technique and postoperative analgesia, and oral intake requirements. Furthermore, only one trial examined the effect of gum chewing on bowel motility within an enhanced recovery program. The next review published was by Noble et al.⁵⁹ who included 9 trials for a total 437 patients. They found a mean reduction of time to flatus of 14 hours (95% CI -20 to -8h, $p < 0.001$) and time to bowel movement of 23 hours (95% CI: -31 to -15, $p < 0.001$). In addition, they found a mean reduction in length of stay of 1.1 days (-1.9, -0.2, $p = 0.016$). Of note, the trial by Kouba et al⁶⁰ dominated the results; however, the trial itself was not conducted in a randomized manner. In addition, the authors also included one trial that investigated undefined gastrointestinal surgery solely on children.⁶¹ As such; the results from this systematic review are difficult to interpret considering the trials that were included. The final review was conducted by Fitzgerald et al⁶² who included seven randomized controlled trials with 272 adult patients who had undergone elective open or laparoscopic gastrointestinal surgery for any indication. In regards to bowel motility, the time to first flatus favored treatment with a 12.6 hour (17%) reduction (95% CI -21.49 to -3.72, $p = 0.005$) and time to first bowel movement favored treatment with a 23.11 hour (22%) reduction in time to first bowel movement (95% CI -34.32 to -11.91, $p < 0.0001$). The authors showed a non-statistically significant trend towards lower length of stay in the treatment group, with a 23.88 hour (12%) reduction (95% CI -53.19 to +5.53, $p = 0.11$). Finally, the authors found no statistically significant differences between laparoscopic or open surgery groups.

In summary, the preliminary data tends to favor the use of chewing gum for the reduction of a postoperative ileus. The main advantage to using chewing gum is that it is inexpensive, well tolerated, and widely available. Furthermore, the use of chewing gum should not substitute for previously proven methods that are included in the enhanced recovery protocols; rather, it may be of benefit as either an add on therapy or in patients who are unable to tolerate early enteral feeds. In order to draw an appropriate conclusion on the effectiveness of chewing gum therapy; further, large scale, randomized trials are needed.

3.5 Optimal Duration of Urinary Drainage

- 3.5.1 All patients undergoing surgery with a low colorectal anastomosis or coloanal anastomosis (≤ 6 cm the anal verge) should have their urinary catheter removed within 72 hours after the surgery (Level of evidence: High)**
- 3.5.2 For patients undergoing some colon resections, it may be appropriate to not insert a urinary catheter. If patients do require a urinary catheter it should be removed within 24 hours after the surgery (Level of evidence: High)**

3.5.3 The above recommendations apply to patients with or without an epidural catheter at the time of removal (Level of evidence: Moderate-High)

3.5.4 The above recommendations do not apply if a catheter is needed for monitoring purposes (Level of evidence: Moderate-Low)

Summary of Evidence

The duration for which a urinary catheter should be left in place after colorectal surgery has been an area of much study and debate. A study by Zmora et al⁶³ included 118 patients who underwent colon and rectal surgery with pelvic dissection via an abdominal approach. In one group a TUC was removed on the 1st postoperative day (POD), whereas in group B and C the catheter was removed on POD 3 and 5 respectively. They found that acute urinary retention requiring catheter reinsertion occurred in 12 (10%) patients. More specifically, retention occurred in 14.6% of pts in whom the catheter was removed on POD 1, compared with 10.5% when the catheter was removed on the 5th POD (p=0.74). A sub-group analysis found that patients with low colorectal anastomosis or coloanal anastomosis (6 cm and below the anal verge) had a significantly increased risk for retention (p= 0.036). They did not note a significant difference with regards to symptomatic bacteriuria, pulmonary complications, or surgical site infections; however, there was a slight trend towards higher rates of the above variables in group C. In regards to TUC in epidural patients, a sub-group analysis noted a trend towards higher rates of urinary retention with the use of epidural analgesia; however, this difference did not reach statistical significance (p=0.15). A study by Benoist et al⁶⁴ assessed 126 patients undergoing rectal resection to compare the results of patients undergoing 1 day of TUC compared to 5 days. In regards to acute urinary retention, in the 1 day group 20 (31%) patients failed to void after catheter removal compared to only 6 (10%) who had their catheter removed after 5 days (p<0.05). The UTI rate was 13/64 in the 1 day group (20%) compared to 26/62 in the 5 day group (42%, p<0.01). According to gender, UTI rates were similar in both groups for men but significantly higher in the 5 day group for women (17/33, 51% compared to 8/31, 26%, p<0.05). A sub-group analysis identified risk factors that predisposed patients to acute urinary retention including, carcinoma of the low rectum and metastatic lymph node involvement. After selectively removing these patients from each group, the 1 day and 5 day group included 43 and 45 patients respectively. In these patients the acute urinary retention rate was comparable in both groups (not significant); however, the UTI rate remained significantly lower in the 1 day group (5/43, 12% compared to 18/45, 40%, p<0.01).

A great deal of debate has centered on the use of urinary catheters and epidural analgesia. Many surgeons feel that the urinary catheter should be kept in place until the epidural is removed. This is based on the concern that epidural analgesia will result in decreased sensation of urgency and impaired bladder detrusor contraction, ultimately leading to urinary retention.⁶⁵ Basse et al⁶⁶ conducted an uncontrolled study of 102 consecutive patients undergoing elective colon resection. The intraoperative inserted TUC was removed routinely in the morning on the first POD and the epidural catheter was removed routinely in the morning of the second POD. They found that only 9 patients had postoperative urinary retention and after discharge only 4 patients had urinary infection. None of the surviving 95

patients had urinary problems at the 30 day follow up. The largest study to date was completed by Zaouter et al⁶⁷ who included 215 patients who were scheduled for thoracic and abdominal surgery. The patients all received thoracic epidural analgesia and were subsequently randomized to have the TUC removed on either the same morning after surgery or at the standard time (3-5 days after surgery). They recorded a total of 17 UTIs, of which 15 occurred in the standard group and 2 in the early removal group (p=0.004). They also matched patients for the types of surgery performed and found that the duration of hospital stay was significantly longer for the patients who developed a UTI (p=0.004). Finally, the incidence of re-catheterizations was not different between the 2 groups (p=0.09).

3.6 Perioperative Pain Management (refer to BPIGS Guideline #6)

Section 4. External Review Process

Reviewer Comment: In recommendation 2.3.9 it suggests replacing blood loss with colloids in a ratio of 3:1. To me that means that if you lose 1 ml of blood you should give 3 ml of colloid. That is not correct. I am not sure what they meant. If you replace blood loss with crystalloid, the classic ratio is 3:1 but if you use colloid it should be 1:1. Please check with your team what they meant to say.

Author's Response: Agree. The guideline recommendation has been changed to read "blood should be replaced with 1:1 colloid"

Reviewer Comment: In 2.3.10, it says to reserve normal saline for patients who are hyponatremic and hyperchloremic. I believe this should read hypochloremic. Apart from that I have no other suggestions.

Author's Response: Agree and the change to the guideline recommendation has been made

Reviewer comment: The group here is mostly concerned with the NPO guidelines being given to patients. Currently it reads NPO after 2 AM and clear fluids until 2-3 hours before surgery. Many times we induce our patients at 7:45 and that is less than the current guidelines from the CAS for NPO (6 hours after a light meal)

Author's response: We agree with your concerns. We have modified the guideline to state that patients should be allowed to eat solid foods until midnight rather than 2 AM in order to minimize confusion about what patients can eat and up to what time. The guideline does recommend that patients should be "encouraged" to drink clear liquids up to **2 hours** before surgery or before they leave home.

Reviewer comment: The CAS guidelines only apply to patients with normal gastric emptying. Patients with diabetes or who are obese or with other mechanical problems are often considered to be full stomach despite fasting so is it wise to be feeding them so close to the OR and risk aspiration. Unfortunately I didn't see Dr. Carli's presentation but I have been given a copy of his slides. I see that he clearly mentions on one of his slides that "Patients with the following conditions should be kept NPO from midnight" and he goes on to list: taking opioids, history of GERD, heartburn and any patients on PPI, history of previous difficult intubation, diabetes mellitus, morbid obesity, achalasia, neurological disease, pregnancy or on fluid restriction (dialysis, CHF). To this end, does it make more sense to have a space on the patient information brochure to write in the NPO time rather than having all patients think they can eat until 2am?

Author's response: The guideline states that "For patients who are undergoing elective colorectal surgery and a significant delay in gastric emptying is not suspected". However, we will add the specific conditions which might affect gastric emptying in the pre-operative orders

Reviewer Comments: The department also was in debate about orange juice being classified as a clear fluid for 2 hours before surgery, even without pulp. (And lemonade for that matter).

Author's response: The guideline only recommends that the patients should drink clear liquids. In the patient education booklet, we will clarify that orange juice is not considered a clear fluid

References

1. Adamina M, Kehlet H, Tomlinson GA, Senagore AJ, Delaney CP. Enhanced recovery pathways optimize health outcomes and resource utilization: a meta-analysis of randomized controlled trials in colorectal surgery. *Surgery*. 2011 Jun;149(6):830-40.
2. Lassen K, Soop M, Nygren J, Cox PB, Hendry PO, Spies C, von Meyenfeldt MF, Fearon KC, Revhaug A, Norderval S, Ljungqvist O, Lobo DN, Dejong CH; Enhanced Recovery After Surgery (ERAS) Group. Consensus review of optimal perioperative care in colorectal surgery: Enhanced Recovery After Surgery (ERAS) Group recommendations. *Arch Surg*. 2009 Oct;144(10):961-9.
3. Zargar-Shoshtari K, Hill AG. Optimization of perioperative care for colonic surgery: a review of the evidence. *ANZ J Surg*. 2008 Jan-Feb;78(1-2):13-23.
4. Kiecolt-Glaser JK, Page GG, Marucha PT, MacCallum RC, Glaser R. Psychological influences on surgical recovery: perspectives from psychoneuroimmunology. *Am Psychol*. 1998;53(11):1209-1218.
5. Devine EC. Effects of psychoeducational care for adult surgical patients: a meta-analysis of 191 studies. *Patient Educ Couns*. 1992 Apr;19(2):129-42.
6. Hathaway D. Effect of preoperative instruction on postoperative outcomes: a meta-analysis. *Nurs. Res*. 1986; 35: 269–75.
7. Mullen P, van den Borne B, Breemhaar B. Implementing a surgery-patient education program as a routine practice: a study conducted in two Dutch hospitals. *Patient Educ Couns*. 2000 Sep;41(2):223-34.
8. Halaszynski TM, Juda R, Silverman DG. Optimizing postoperative outcomes with efficient preoperative assessment and management. *Crit Care Med*. 2004; 32(4)(suppl):S76-S86.
9. Forster AJ, Clark HD, Menard A, et al. Effect of a nurse team coordinator on outcomes for hospitalized medicine patients. *Am J Med*. 2005;118(10):1148-1153.
10. Disbrow EA, Bennett HL, Owings JT. Effect of preoperative suggestion on postoperative gastrointestinal motility. *West J Med*. 1993;158(5):488-492.
11. Tryba M, Zenz M, Mlasowsky B, Huchzermeyer H. Does stomach tube enhance regurgitation during general anaesthesia? *Anaesthetist* 1983;32:407-9.
12. Plourde G, Hardy JF. Aspiration pneumonia: assessing the risk of regurgitation in the cat. *Can Anesth Soc J* 1986;33:345-48.
13. Phillips S, Hutchinson S, Davidson T. Preoperative drinking does not affect gastric contents. *Br J Anaesth* 1993;70:6-9.
14. Soreide E, Stromskag KE, Steen PA. Statistical aspects in studies of preoperative fluid intake and gastric content. *Acta Anaesthesiol Scand* 1995;39:738-43.
15. Brady MC, Kinn S, Stuart P, Ness V. Preoperative fasting for adults to prevent perioperative complications. *The Cochrane Collaboration* 2003;4:CD004423.
16. Kaska M, Grosmanová T, Havel E, Hyspler R, Petrová Z, Brtko M, Bares P, Bares D, Schusterová B, Pyszková L, Tosnerová V, Sluka M. The impact and safety of preoperative oral or intravenous carbohydrate administration versus fasting in colorectal surgery--a randomized controlled trial. *Wien Klin Wochenschr*. 2010 Jan;122(1-2):23-30.

17. Hausel J, Nygren J, Lagerkranser M, Hellström PM, Hammarqvist F, Almström C, Lindh A, Thorell A, Ljungqvist O. A carbohydrate-rich drink reduces preoperative discomfort in elective surgery patients. *Anesth Analg*. 2001 Nov;93(5):1344-50.
18. Soreide E, Hausken T, Soreide JA, Steen PA. Gastric emptying of a light hospital breakfast. A study using real time ultrasonography. *Acta Anaesthesiol Scand* 1996;40:549-53.
19. Minami H, McCallum RW. The physiology and pathophysiology of gastric emptying in humans. *Gastroenterology* 1984;86:1592-1610.
20. Petring OU, Blake DW. Gastric emptying in adults: an overview related to anaesthesia. *Anaesth Intensive Care* 1993;21:774-81.
21. American Society of Anesthesiologists (ASA). Practice guidelines for preoperative fasting and the use of pharmacologic agents to reduce the risk of pulmonary Aspiration: application to healthy patients undergoing elective procedures: Updated Report. *Anesthesiology* 2011;114:495-511.
22. Norwegian National Consensus Guidelines (NNCG). Pre-operative fasting guidelines: an update. *Acta Anaesthesiologica Scandinavia* 2005;49(8):1041-47.
23. Simini B. Preoperative fasting. *Lancet* 1999;325:862.
24. Bundgaard-Nielsen M, Secher NH, Kehlet H. 'Liberal' vs. 'restrictive' perioperative fluid therapy--a critical assessment of the evidence. *Acta Anaesthesiol Scand*. 2009 Aug;53(7):843-51.
25. Brandstrup B, Tønnesen H, Beier-Holgersen R, Hjortsø E, Ørding H, Lindorff-Larsen K, Rasmussen MS, Lanng C, Wallin L, Iversen LH, Gramkow CS, Okholm M, Blemmer T, Svendsen PE, Rottensten HH, Thage B, Riis J, Jeppesen IS, Teilmann D, Christensen AM, Graungaard B, Pott F; Danish Study Group on Perioperative Fluid Therapy. Effects of intravenous fluid restriction on postoperative complications: comparison of two perioperative fluid regimens: a randomized assessor-blinded multicenter trial. *Ann Surg*. 2003 Nov;238(5):641-8.
26. Holte K, Foss NB, Andersen J, Valentiner L, Lund C, Bie P, Kehlet H. Liberal or restrictive fluid administration in fast-track colonic surgery: a randomized, double-blind study. *Br J Anaesth*. 2007 Oct;99(4):500-8.
27. Senagore AJ, Emery T, Luchtefeld M, Kim D, Dujovny N, Hoedema R. Fluid management for laparoscopic colectomy: a prospective, randomized assessment of goal-directed administration of balanced salt solution or hetastarch coupled with an enhanced recovery program. *Dis Colon Rectum*. 2009 Dec;52(12):1935-40.
28. Lobo DN, Bostock KA, Neal KR, Perkins AC, Rowlands BJ, Allison SP. Effect of salt and water balance on recovery of gastrointestinal function after elective colonic resection: a randomised controlled trial. *The Lancet*. 2002 May;359(9320):1812-1818,
29. MacKay, G., Fearon, K., McConnachie, A., Serpell, M. G., Molloy, R. G. and O'Dwyer, P. J. (2006), Randomized clinical trial of the effect of postoperative intravenous fluid restriction on recovery after elective colorectal surgery. *British Journal of Surgery*, 93: 1469–1474.
30. Rahbari NN, Zimmermann JB, Schmidt T, et al. Meta-analysis of standard, restrictive and supplemental fluid administration in colorectal surgery. *Br J Surg*. 2009;96:331–341.
31. Conway DH, Mayall R, Abdul-Latif MS, et al. Randomized controlled trial investigating the influence of intravenous fluid titration using esophageal Doppler monitoring during bowel surgery. *Anaesthesia*. 2002;57:845–849.

32. Wakeling HG, McFall MR, Jenkins CS, et al. Intraoperative esophageal Doppler guided fluid management shortens postoperative hospital stay after major bowel surgery. *Br J Anaesth.* 2005;95:634–642.
33. Boldt J. Fluid management of patients undergoing abdominal surgery—more questions than answers. *Eur J Anaesthesiol.* 2006;23:631–640.
34. Grocott MP, Mythen MG, Gan TJ. Perioperative fluid management and clinical outcomes in adults. *Anesth Analg.* 2005;100:1093–1106.
35. Ostgaard G, Reed RK. Interstitial fluid accumulation does not influence oxygen uptake in the rabbit small intestine. *Acta Anaesthesiol Scand.* 1995;39:167–173.
36. Gow KW, Phang PT, Tebbutt-Speirs SM, et al. Effect of crystalloid administration on oxygen extraction in endotoxemic pigs. *J Appl Physiol.* 1998;85:1667–1675.
37. Kellum JA. Saline-induced hyperchloremic metabolic acidosis. *Crit Care Med.* 2002;30:259–261.
38. Holte K, Nielsen KG, Madsen JL, Kehlet H. Physiologic effects of bowel preparation. *Dis Colon Rectum* 2004;47(8): 1397–1402
39. Holte K, Kehlet H. Compensatory fluid administration for preoperative dehydration—does it improve outcome? *Acta Anaesthesiol Scand* 2002;46(9):1089–1093
40. Bucher P, Mermillod B, Gervaz P, Morel P. Mechanical bowel preparation for elective colorectal surgery: a meta-analysis. *Arch Surg* 2004;139(12):1359–1364; discussion 1365
41. de Jesus EC, Karliczek A, Matos D, et al. Prophylactic anastomotic drainage for colorectal surgery. *The Cochrane Collaboration* 2004;2:CD002100.
42. Petrowsky H, Demartines N, Rousson V, Clavien PA. Evidence-based value of prophylactic drainage in gastrointestinal surgery. *Annals of Surgery* 2004;240:1074-85.
43. Urbach DR, Kennedy ED, Cohen MM. Colon and rectal anastomoses do not require routine drainage. *Ann Surg* 1999;229:174-80.
44. Nelson RL, Verma R. Prophylactic nasogastric decompression after abdominal surgery. *Cochrane Database Syst Rev* 2010;3:CD004929.
45. Kerger KH, Mascha E, Steinbrecher B, et al. Routine use of nasogastric tubes does not reduce postoperative nausea and vomiting. *Ambulatory Anesthesiology* 2009;109;768-73.
46. Khoo CK, Vickery CJ, Forsyth N, et al. A prospective randomized controlled trial of multimodal perioperative management protocol in patients undergoing elective colorectal resection for cancer. *Annals of Surgery* 2007;245(6):867-72.
47. Bardram L, Funch-Jensen P, Jensen P, et al. Recovery after laparoscopic colonic surgery with epidural analgesia, and early oral nutrition and mobilization. *Lancet* 1995;345:763-4.
48. Lee TG, Kang SB, Kim DW, et al. Comparison of early mobilization and diet rehabilitation program with conventional care after laparoscopic colon surgery: a prospective randomized controlled trial. *Dis Colon Rectum* 2011;54:21-8.
49. Henriksen MG, Jensen MB, Hansen HV, et al. Enforced mobilization, early oral feeding, and balanced analgesia improve convalescence after colorectal surgery. *Nutrition* 2002;18:147-52.
50. Henriksen MG, Hansen HV, Hessov I. Early oral nutrition after elective colorectal surgery: influence of balanced analgesia and enforced mobilization. *Nutrition* 2002;18:263-7.
51. Lin JS, Whelan RL, Sakellarios NE, et al. Prospective study of ambulation after open and laparoscopic colorectal resection. *Surgical Innovation* 2009;16(1):16-20.

52. Massey RL. A randomized trial of rocking-chair motion on the effect of postoperative ileus duration in patients with cancer recovering from abdominal surgery. *Applied Nursing Research* 2010;23:59-64.
53. Andersen HK, Lewis SJ, Thomas S. Early enteral nutrition within 24h of colorectal surgery versus later commencement of feeding for postoperative complications. *Cochrane Database Syst Rev* 2009;4:CD004080.
54. Han-Geurts IJ, Hop WC, Kok NF, et al. Randomized clinical trial of the impact of early enteral feeding on postoperative ileus and recovery. *British Journal of Surgery* 2007;94:555-61.
55. El Nakeeb A, Fikry A, El Metwally T, et al. Early oral feeding in patients undergoing elective colonic anastomosis. *International Journal of Surgery* 2009;7:206-9.
56. Asao T, Kuwano H, Nakamura J, et al. Gum chewing enhances early recovery from postoperative ileus after laparoscopic colectomy. *J Am Coll Surg* 2002;195:30-2.
57. Chan MK, Law WL. Use of chewing gum in reducing postoperative ileus after elective colorectal resection: a systematic review. *Diseases of the Colon & Rectum* 2007;50:2149-57.
58. Parnaby CN, MacDonald AJ, Jenkins JT. Sham feed or sham? A meta-analysis of randomized clinical trials assessing the effect of gum chewing on gut function after elective colorectal surgery. *Int J Colorectal Dis* 2009;24:585-92.
59. Noble EJ, Harris R, Hoise KB, et al. Gum chewing reduces postoperative ileus? A systematic review and meta-analysis. *International Journal of Surgery* 2009;7:100-5.
60. Kouba EJ, Wallen EM, Pruthi RS. Gum chewing stimulates bowel motility in patients undergoing radical cystectomy with urinary diversion. *Urology* 2007;70:1053-56.
61. Zhang Q, Zhao P. Influence of gum chewing on return of gastrointestinal function after gastric abdominal surgery in children. *Eur J Pediatr Surg* 2008;18:44-6.
62. Fitzgerald JE, Ahmed I. Systematic review and meta-analysis of chewing-gum therapy in the reduction of postoperative paralytic ileus following gastrointestinal surgery. *World J Surg* 2009;33:2557-66.
63. Zmora O, Madbouly K, Tulchinsky H, et al. Urinary bladder catheter drainage following pelvic surgery – is it necessary for that long? *Dis Colon Rectum* 2010;53:321-6.
64. Benoist S, Panis Y, Denet C, et al. Optimal duration of urinary drainage after rectal resection: A randomized controlled trial. *Surgery* 1999;125:135-41.
65. Baldini G, Bagry H, Aprikian A, Carli F. Postoperative urinary retention: anesthetic and perioperative considerations. *Anesthesiology* 2009;110:1139-57.
66. Basse L, Werner M, Kehlet H. Is urinary drainage necessary during continuous epidural analgesia after colonic resection? *Reg Anesth Pain Med* 2000;25:498-501.
67. Zaouter C, Kaneva P, Carli F. Less urinary tract infection by earlier removal of bladder catheter in surgical patients receiving thoracic epidural analgesia. *Reg Anesth Pain Med* 2009;34:542-8.