Review

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A Comprehensive Review of Evidence-Based Strategies to Prevent and Treat Postoperative Ileus

Sara K. Story[a] Ronald S. Chamberlain[b]

[a] Saint George's University School of Medicine, Grenada, West Indies; [b] Surgery, Saint Barnabas Medical Center, Livingston, N.J., and Surgery, University of Medicine and Dentistry of New Jersey, Newark, N.J., USA

Key Words

Alvimopan · Bowel distention · Methylnaltrexone · Postoperative ileus

Abstract

Background: Postoperative ileus (POI) is a common complication of abdominal and several other surgeries leading to increased hospital stay and healthcare costs. POI also contributes towards numerous postsurgical comorbidities including deep vein thrombosis and pneumonia. POI is characterized by bowel distention and lack of bowel sounds, flatus and bowel movements. The causative mechanism is not fully understood and may be multifactorial including disorganized electrical activity, activation of inflammatory mediators and the use of opioid analgesics. ***Methods:*** A selective review of the literature pertaining to the prevention and treatment of adynamic ileus and POI was completed. More specifically we sought to evaluate RCTs, meta-analyses, consensus statements and articles providing graded evidence-based data on POI prevention and treatment. ***Results:*** Perioperative strategies employed to prevent or limit the duration of POI include avoidance of preoperative fasting and mechanical bowel preparation, use of epidural-local anesthetics, implementation of minimally-invasive surgical techniques, and modification of pain management strategies to limit opioid administration among others. ***Conclusion:*** Though many of these strategies have proven beneficial, no single approach has demonstrated the ability to prevent or treat POI. However, when these strategies are used in combination as part of a fast-track multimodal treatment plan, there is a significant decrease in time to return of normal bowel function and a shortened hospital stay. Additional studies are needed to make specific recommendations regarding which components of fast-track protocols are most beneficial.

Introduction

Postoperative ileus (POI) is the most common cause of prolonged hospital stay following abdominal surgery [1]. A recent analysis of 161,000 major bowel resections performed between 1999 and 2000, as listed in the Health Care Financing Administration (HCFA) database, found that the length of stay increased by 5 days in cases with a coded POI [2]. This same analysis found the readmission rate for patients with documented POI to be 3.6% compared to 0.2% in all other patients [1, 2]. In these cases the extra hospitalization costs attributed to POI was USD 1.14 billion, and total healthcare cost was significantly

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Ronald Scott Chamberlain, MD
94 Old Short Hills Road
Livingston, NJ 07039 (USA)
Tel. +1 973 322 5195, Fax +1 973 322 2471
E-Mail rchamberlain@sbhcs.com

higher (USD 16,000/patient with POI vs. USD 10,000/patient without POI; $p < 0.01$) [1]. An alternate study by Iyer and Saunders [3] had similar findings when looking at 17,896 patients listed in the Perspective Comparative Database (PCD) who had undergone partial excision of the large intestine. Of this cohort, 17.4% (3115) had a secondary diagnosis of POI and a significantly longer average length of stay (13.75 ± 13.33 days with POI vs. 8.85 ± 9.49 days without POI; $p < 0.001$).

POI contributes to many comorbid postsurgical complications which include delayed surgical wound healing and ambulation, atelectasis, pneumonia and DVTs [4]. In addition to contributing towards postoperative morbidities, these complications also increase the length of hospital stay, resource use and associated healthcare costs [4]. For example, the relationship between POI and deep vein thrombosis (DVT) was examined by reviewing the clinical course of 2,949 patients undergoing 3,364 consecutive primary and revision total hip and total knee arthroplasties, radical debridements, and reimplantations. Ileus occurred in 62 patients (2.1%) and symptomatic DVT in 51 (1.7%). In patients with ileus, the incidence of DVT was 8.1% (OR = 5.5; $p = 0.0036$). Symptomatic pulmonary embolism occurred in 7 patients who did not have ileus (0.24%); in patients with ileus, the incidence was 3.2% (OR = 19.6; $p < 0.0082$) [5]. In addition, POI is associated with a significantly higher in-hospital mortality compared with patients not experiencing POI (mortality: 6.5% vs. 2.3%, $p < 0.01$) [1]. The fiscal benefit which can accrue from decreasing hospital stay by even a single day is substantial and warrants close scrutiny into the mechanisms and prevention of POI [3]. In this review, we examine the causes, prevention and treatment of POI and discuss current evidence-based strategies that may limit associated morbidity and mortality as well as decrease length of stay and associated hospital costs.

Methods

A systematic review of the English language scientific literature from 1978 to 2008 was performed using the Medline, the Embase, and the Cochrane Central Register of Controlled Trials to obtain access to all publications including randomized controlled trials (RCTs), meta-analyses and systemic reviews pertaining to the causes, prevention and treatment of POI. The search strategy described by Robinson and Dickersin [6] was followed using key words such as ileus, bowel obstruction, prokinetic, mechanical, adynamic, treatment, and prevention. Articles were retrieved and reviewed, and the evidence from medical literature in combination with consensual clinical experience was applied to develop strategies to prevent and treat POI.

Definition of Postoperative Ileus

POI is described as a transient impairment of bowel motility that may occur after major surgery [7, 8]. An initial delay of bowel motility for 1–2 days appears to be an obligatory part of the normal surgical recovery process; however, prolongation of this period has been associated with the development of substantial in-hospital morbidity and mortality [8, 9]. POI is considered an iatrogenic condition occurring with highest frequency and duration in association with abdominal surgeries, though it is also a consequence of other surgical procedures, including hip-fracture repair, spine procedures, neurosurgical procedures, arthroscopic surgery and others [5, 10, 11].

The underlying pathology of POI is best described as a lack of coordinated bowel activity. Postoperative hypomotility affects all segments of the gastrointestinal (GI) tract and recovery differs by segment [12–14]. Inhibited motility in the small intestine is usually transient, recovering within several hours of surgery [12, 14, 15]. Gastric motility typically recovers within 24–48 h after surgery [5, 9], whereas the colon, the final portion of the GI tract to return to normal, usually recovers 48–72 h postsurgery [12–16]. Recovery of colonic motility is usually the limiting factor in resolving POI [15, 17].

POI: Who Is at Risk?

Compelling data which permit the accurate prediction of patients most at risk for POI are lacking; however, several studies have examined this issue. In a study of 666 patients with nonruptured abdominal aortic aneurysms, logistic regression analysis showed POI to be related to aortoiliac occlusive disease, deterioration of renal function, prolonged ventilation, and preoperative history of angina [18]. A recent retrospective study of 88 abdominal surgery patients found that the duration of POI correlates with total surgery time, blood loss and total opiate dose [19]. Gervaz et al. [20] studied 124 patients undergoing laparotomy for colectomy (median age, 68 years) and found the duration of ileus significantly reduced in those cases performed by a colorectal surgeon and when opioid analgesia lasted for less than 2 days.

Mechanical trauma of the GI tissue and the release of inflammatory mediators and cytokines have been implicated in the development of POI [8]. Given that fact, it might be expected that those undergoing a minimally invasive or laparoscopic procedure would have less risk of developing POI than those undergoing an open procedure [19]. Holte et al. [21] reviewed 4 studies focusing on the effects of laparoscopic surgery on POI and found varied results with two studies showing that laparoscopic procedures reduced POI and 2 studies showing no difference.

Though POI is most often associated with abdominal surgery, it is also seen in cardiothoracic surgery, hip fracture repair, spine procedures, neurosurgical procedures, arthroscopic surgery, gynecologic surgery, genitourinary surgery, and abdominal wall herniography among others [5, 10, 11]. Notably, POI is a complication of up to 4% of both total hip and total knee arthroplasties and abdominal hysterectomies [1, 5].

POI: Clinical Spectrum of Presentation

Gastrointestinal motility is expected to return to normal within 2–3 days postsurgery; when this does not occur, POI should be suspected [12–16]. That said, diagnosing POI can be complicated as the presentation is variable and difficult to distinguish from a mechanical bowel obstruction. In both cases, abdominal X-rays typically show small bowel distention with air fluid levels at various points in the intestine. Although the shape of the air fluid levels (J loops or U loops) may be suggestive of mechanical small bowel obstruction over POI, neither these findings nor evidence of air in the colon is diagnostic since the latter can be seen with partial small bowel obstruction as well.

Clinically, POI is characterized by bowel distension and lack of bowel sounds, flatus and bowel movements [7]. Symptoms include nausea, vomiting and stomach cramps [12]. Other potentially adverse effects of POI include increased postoperative pain; delayed oral intake; poor wound healing; delayed postoperative mobilization; increased risk of pulmonary complications, including pneumonia, pulmonary embolism, and atelectasis; prolonged hospitalization; decreased patient satisfaction and increased health care costs [15].

POI: Mechanism of Disease

After surgery, inhibited motility of the GI tract is universally related to disorganized electrical activity and lack of coordinated propulsion [15, 22]. The mechanisms involved in POI and the disorganized electrical activity following surgery are not well defined and are likely multifactorial. More specifically, a variety of factors worth addressing are inhibitory sympathetic input; release of hormones, neurotransmitters and inflammatory mediators including cytokines, prostaglandins and nitric oxide [7, 12, 15]. Opioids, which are used universally as analgesics following various surgeries, also have a major importance in the pathogenesis of POI due to the depressive effects on GI transit [21]. Excessive intravascular volume given in the perioperative period may also contribute to POI development by causing intestinal edema. Figure 1 provides a complete outline of the most significant mechanisms associated with the development of POI.

POI: Prevention and Treatment Strategies

A number of perioperative strategies have been instituted or modified attempting to prevent the development or reduce the incidence and/or duration of POI (table 1). Some of these have shown independent benefits, whereas others might be beneficial only in the context of a multimodality approach. Still others incorporated in the past have been shown to be counterproductive, and their use is now discouraged based on more recent information.

Preoperative Bowel Preparation

Perioperative mechanical bowel preparation has been a cornerstone of colon surgery for decades; however, recent studies suggest it may be unnecessary and even deleterious [23]. Bucher et al. [24] reported that mechanical bowel preparation can lead to increased risk of anastomotic leaks and does not decrease the risk of septic complication. A systemic review of 9 RCTs including over 1,500 patients by Guenaga et al. [25] also found that mechanical bowel preparation did not decrease the incidence of anastomotic leaks, but actually increased the rate at which they occur as well as increasing the rate of wound infections. A randomized prospective trial of patients undergoing elective colorectal surgery demonstrated similar results, finding no benefit to routine bowel preparation [23]. Finally, Shafii et al. [26] evaluated 86 patients undergoing cystectomy and urinary diversion and reported that bowel preparation significantly increased incidence of POI and length of hospital stay.

Probiotics and Carbohydrate Loading

In recent years, new information promoting the administration of preoperative nutritional support to assist in bowel recovery following surgical procedures has begun to emerge. Probiotics are the most investigated nutritional aid to date. A 2006 review by Bengmark and Gil

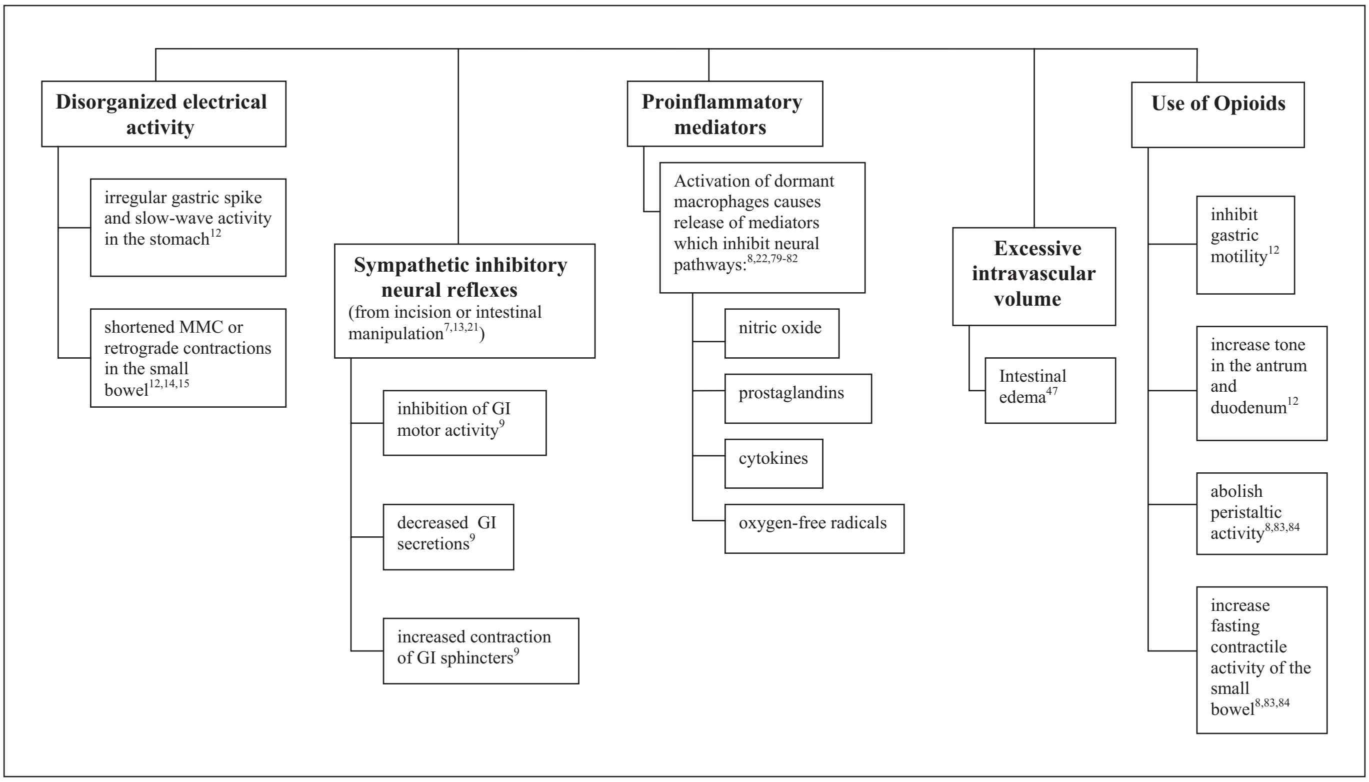

Fig. 1. Mechanisms of POI.

Table 1. Therapeutic modalities for the prevention and treatment of POI

Treatment modality	Effect on POI	Level of evidence*
Nonpharmacological methods		
Nasogastric decompression	no demonstrable benefit shown increased overall complications	Ia
Minimally invasive surgery	probably beneficial	Ia
Early ambulation	no demonstrable benefit shown	Ib
Early enteral feeding	modestly beneficial	Ia
Gum chewing ('sham-feeding')	possibly beneficial	Ia
Pharmacological methods		
Stop routine preoperative bowel preparation	beneficial	Ia
Limited intravenous fluids administration	probably beneficial	Ib
Epidural analgesia	beneficial	Ia
Preoperative probiotics administration	possibly beneficial	II
Preoperative carbohydrate loading	probably beneficial	Ib
Preoperative COX-2 inhibitors	probably beneficial	II
Postoperative administration of opioid antagonists	probably beneficial	Ib
Prokinetic agents	may be beneficial	Ia
Multimodal fast-track approaches	beneficial	Ib

* Levels of evidence categories taken from the World Health Organization http://www.euro.who.int.

[27] found that using oral preparations of specific lactobacillus in the pre- and postoperative period may help maintain GI motility and prevent POI. However, preoperative use of these preparations has not been widely adopted and further studies are still to determine the significance of their use.

Traditionally, preoperative orders for patients have included fasting overnight before surgery to avoid complications during surgical procedures. More recently, studies have shown that using carbohydrate-rich liquids within hours prior to surgery shortens bowel recovery time postoperatively [28–30]. Noblett et al. [28] compared 36 patients of which one third were given a carbohydrate drink prior to surgery. They found that this group had a significant decrease in hospital stay when compared with those that fasted or were given an equivalent amount of water prior to surgery. A trend towards earlier normalization of GI function in the carbohydrate group was found, although it was not significant [31]. These findings were mirrored in literature reviews performed by Fearon and Luff [30], as well as Nygren et al. [29].

Epidural Local Anesthetics

As outlined earlier (fig. 1), several inhibitory reflexes in the GI tract have been proposed to play a role in POI, including activation of inhibitory reflexes originating from the incision and/or manipulation of the intestines [7, 21]. It has been hypothesized that epidural local anesthetics may decrease POI by blocking these afferent sympathetic inhibitory reflexes, as well as efferent sympathetics with a concomitant increase in splanchnic blood flow. Systemic absorption of local anesthetics may also have anti-inflammatory effects [7, 32, 33].

Randomized clinical trials examining continuous thoracic epidural blockade with local anesthetics for more than 24 h have reported a decrease in POI compared with systemic opioid administration [21, 34]. Furthermore, a meta-analysis of 5 randomized clinical trials with 261 patients concluded that epidural local anesthetics reduced POI (measured as time to the first passage of stool) by 37 h compared with systemic opioids and 24 h compared with epidural opioids [34]. However, despite this positive effect on POI, epidural local anesthetics alone have not been shown to decrease hospital stay [35, 36]. A recent meta-analysis of 16 trials found that whereas epidural anesthesia significantly decreased the duration of POI compared with parenteral opioid analgesia after colorectal surgery (weighted mean difference (WMD) –1.55 days; 95% CI –2.27 to –0.84), it did not influence the duration of hospital stay (WMD 0.07 days; 95% CI –0.40 to 0.54) [36]. However, when epidural anesthetics were incorporated as part of a multicomponent fast-track perioperative care program, Wind et al. [37] demonstrated shorter hospital stays after elective colorectal surgery.

COX-2 Inhibitors

Because of the role of prostaglandins in the inflammatory response, it has been suggested that NSAIDs or COX-2 inhibitors might be used to increase GI motility as well as to reduce opioid use postoperatively [21]. Perioperative administration of COX-2 inhibitors has been found to reduce opioid administration, pain and vomiting after joint replacement surgery [38–40]. Rofecoxib, administered perioperatively, was found to be an effective component of multimodal analgesia for controlling postoperative pain after total knee arthroplasty [38]. Likewise, valdecoxib in combination with morphine was found to provide multimodal analgesia that reduced both pain and opioid use, and increased patient satisfaction following knee replacement surgery [40]. Administration of parecoxib sodium with PCA morphine resulted in significantly improved postoperative analgesic management after total hip arthroplasty, as defined by reduced opioid requirement, lower pain scores, reduced time on PCA morphine and higher global evaluation ratings [39]. Although similar studies with COX-2 inhibitors used in patients undergoing abdominal surgery are limited, a recent study with 40 patients found evidence that COX-2 inhibitors had opioid-sparing effects and reduced ileus after colorectal resection [31]. In patients administered valdecoxib 40 mg pre- and postoperatively, bowel sound and first bowel movement appeared at medians of 12 and 72 h versus 24 and 84 h, respectively, in controls ($p < 0.05$). Tolerance of solid diet was at a median of 60 h with discharge at a median of 4 days when patients received valdecoxib versus 72 h and 6 days in controls ($p < 0.05$ and $p < 0.01$, respectively) [31]. It is noteworthy to mention that cardiovascular complications potentially attributable to COX-2 inhibitors have significantly limited their current use and study.

Laparoscopic Surgery

Because of experimental evidence linking mechanical trauma of GI tissue to inflammatory factors and cytokines involved in POI [8], one might expect decreased POI rates following laparoscopic as opposed to open surgical procedures. However, a review of 4 studies that examined the effects of laparoscopic surgery on POI found mixed results [21]. In 2 studies, laparoscopic surgery reduced POI, whereas in the other 2 studies it did not [21, 41–44]. Abraham et al. [45] conducted a systematic review of all nonrandomized comparative studies of laparoscopic resection for colorectal cancer. This analysis included 6,438 resections. The authors found that laparoscopic resection took 27.6% (41 min) longer to carry out than open resection. There was no significant difference between the 2 groups in early mortality rates or need for reoperation. The time until passage of first flatus and bowel movement, tolerating oral fluids and a solid diet was 1.2 to 1.6 days (26 to 37%) shorter in the laparoscopic group; measurements of pain and narcotic analgesic requirements were 16 to 35% lower and hospital stay was 3.5 days (18.8%) shorter following laparoscopic resection compared with open resection. Yoshida et al. [46] similarly demonstrated that laparoscopic surgery compared with open laparotomy for cholecystectomy, reduced endogenously produced opioids and cytokines. These results suggest that laparoscopic procedures may be associated with decrease in rates of POI, but other factors may be at work and more investigation is needed.

Intravenous Fluids

A review of data related to high-volume perioperative fluid therapy by Holte et al. [47] raised concerns that resulting overhydration might be detrimental in a number of respects, including impairment of cardiac and pulmonary function and the development of gut edema which would worsen POI. However, 2 more recent randomized, double-blind studies by these same authors did not validate those results, finding no increases in either ileus or hospital stay related to the volume of perioperative fluid administration [48, 49].

Gastric 'Decompression' via Nasogastric Tube (NGT) and the Use of Intraoperative Drains

Nasogastric decompression and the practice of advancing postoperative feeding only after the presence of bowel sounds and/or flatus has been a routine in surgery for decades. However, experience with laparoscopic surgery has taught us much about the archaic nature of this practice. Cheatham et al. [50] published a meta-analysis of all clinical trials comparing selective versus routine nasogastric decompression after elective laparotomy and found that routine insertion of an NGT resulted in increased adverse events including fever, pneumonia and atelectasis. They concluded that only 5% of patients stood to benefit from NGT decompression, and that it should not be routinely utilized. Whether decreasing NGT use, which is associated with decreased ambulation and increased patient discomfort will also decrease POI is not clear but may reasonably be expected.

Similar to the use of NGTs, an obligatory attitude toward intraoperative drain placement has been a common practice in abdominal surgery for over a century [51]. Though they effectively serve to eliminate fluid from surgical sites, they are not without risk. They are a source of wound infection and can lead to increased hospital stay [51]. Kumar et al. [51] randomized 180 patients undergoing subtotal gastrectomy into 2 groups, drain and no-drain. They found no significant difference between the groups in regard to time to return of normal GI motility, length of hospital stay, or overall mortality. Similar findings were attained by Bafna et al. [52] in patients undergoing surgery for gynecologic malignancies. Both studies concluded that drain placement is usually unnecessary since it shows no beneficial effects, except perhaps surgical peace of mind.

Opioids and Opioid Antagonists

Opioids are freely used as methods of pain control following abdominal and other surgeries. With repeated opioid administration for pain relief, tolerance to the analgesic effect subsequently develops; however, tolerance to the GI adverse effects does not [21, 53]. Therefore, limiting opioid use postoperatively has been associated with a significant decrease in POI and remains a mainstay of POI prevention and treatment approaches [15, 54].

An alternative to limiting opioid use is to employ antagonists to counteract opioid effects on gastric motility. Several opiate antagonists have been found to have a beneficial effect [15]. Two novel peripheral opioid antagonists currently being investigated are alvimopan and methylnaltrexone. Both of these agents have a selective affinity for peripheral receptors and do not readily cross the blood-brain barrier. Therefore, they can reverse the negative effects of opioids on the GI tract without blocking the central opioid receptors and reversing pain relief [15, 22, 55–57].

A pooled retrospective subset analysis of bowel resection found that alvimopan significantly reduced the occurrence of nausea, vomiting, NGT insertion and POI after bowel resection. Patients were given alvimopan 6 mg (n = 397), 12 mg (n = 413), or placebo (n = 402) at least 2 h prior to surgery and twice daily until hospital discharge for up to 7 days. Alvimopan (6 or 12 mg) significantly accelerated GI recovery by 12 to 18 h over placebo (hazards ratio = 1.28 and 1.38, respectively; $p < 0.001$ for both). Alvimopan also significantly accelerated time to patient discharge by 16 h for 6 mg and 18 h for 12 mg

($p < 0.001$ for both), from a mean of 147 h for placebo. In addition, alvimopan-treated patients had reduced postoperative morbidity compared with placebo, and their incidence of prolonged hospital stay or readmission was also significantly reduced ($p < 0.001$) [58]. Alvimopan was generally well tolerated and the overall incidence of treatment-emergent adverse events was comparable between groups; the most commonly reported in the North American trials were nausea (alvimopan 12 mg, 55.9%; placebo, 65.3%) and vomiting (alvimopan 12 mg, 18.8%; placebo, 27.1%) [59]. It should be noted that alvimopan is only approved for up to 15 doses since long-term treatment increased the risk for myocardial infarction within the first 4 months of therapy for patients treated with chronic opioids for pain management [60].

Methylnaltrexone is a pure μ-opioid antagonist that is a quaternary derivative of naltrexone, and therefore poorly lipid soluble [61, 62]. It does not cross the blood-brain barrier, penetrate the central nervous system, antagonize the central effects of morphine or precipitate withdrawal [61]. Early experimental studies indicated that parenterally administered methylnaltrexone is active at peripheral rather than central opioid sites [61]. Studies in healthy volunteers indicated that methylnaltrexone could reverse opioid-induced bowel inhibition without reversing analgesia [56, 61]. A randomized controlled trial of methylnaltrexone 0.3 mg/kg administered as a 20-min intravenous infusion every 6 h up to 7 days versus placebo was performed in 65 patients following open segmental colonic resection. Methylnaltrexone-treated patients recovered bowel function more quickly than placebo patients in all measures of upper and lower bowel recovery; the mean differences in most of the parameters of recovery were >1 day. No differences in opioid use or mean pain scores were observed and the drug was well tolerated. Adverse events were similar to placebo. This study suggests that parenteral methylnaltrexone may significantly shorten the duration of postoperative bowel dysfunction following segmental colectomy [56]. At present, methylnaltrexone is not FDA approved for the treatment of POI, but is approved for the treatment of opioid-induced constipation. Further studies are ongoing.

Early Ambulation

It has long been believed that early ambulation increases GI motility and therefore reduces POI. In an effort to discern whether ambulation hastens recovery from ileus following laparotomy, Waldhausen and Schirmer [63] carefully evaluated the effects of early ambulation on 34 consecutive patients. Seromuscular bipolar recording electrodes were placed on the stomach, jejunum and colon at laparotomy. These recordings did not indicate any independent benefit of early ambulation on return of normal GI electrical activity. However, despite this well-designed study, early ambulation is still important to patients in other ways, and remains a major component of most multimodal fast-track approaches to reducing POI.

Postoperative Feeding

Early feeding following intra-abdominal surgery has recently gained favor based on emerging clinical studies [64, 65]. Jeffery et al. [64] found no difference in recovery of patients receiving a clear liquid diet, compared with those receiving a regular diet beginning with the first oral intake after surgery. However, Stewart et al. [65] found that patients in an early oral feeding group passed flatus and moved their bowels much sooner than the control group thus reducing the duration of POI and hospital stay. Though these results are mixed, there is no increase in occurrence of associated complications, leading to a growing popularity of early feeding as a potential strategy to prevent POI [22].

Gum Chewing

Gum chewing has been proposed to assist in postoperative recovery of GI function by serving as a 'sham feeding', thereby stimulating associated neuronal pathways. Although a recent meta-analysis of 5 randomized, controlled studies showed that gum chewing shortened mean time to flatus by 20 h and time to defecation by 29 h, there was a nonsignificant trend toward shorter hospital stay [66].

Prokinetic Agents

Whereas animal studies have suggested that prokinetic agents might be effective treatments of POI, currently approved prokinetics primarily alter upper GI motility and generally have not been effective for treating POI [8]. Traut et al. [67] examined 39 randomized control trials that included the use of erythromycin, cholecystokinin, intravenous lidocaine, neostigmine and other prokinetic agents to evaluate their benefits postoperatively. They found that the use of most agents are not supported in the postoperative period due to their lack of effect. Intravenous lidocaine and neostigmine may be beneficial in certain situations, though further studies are needed.

The effects of stimulating laxatives on POI have been investigated. Zingg et al. [68] studied 200 patients undergoing elective colorectal resections. Patients were ran-

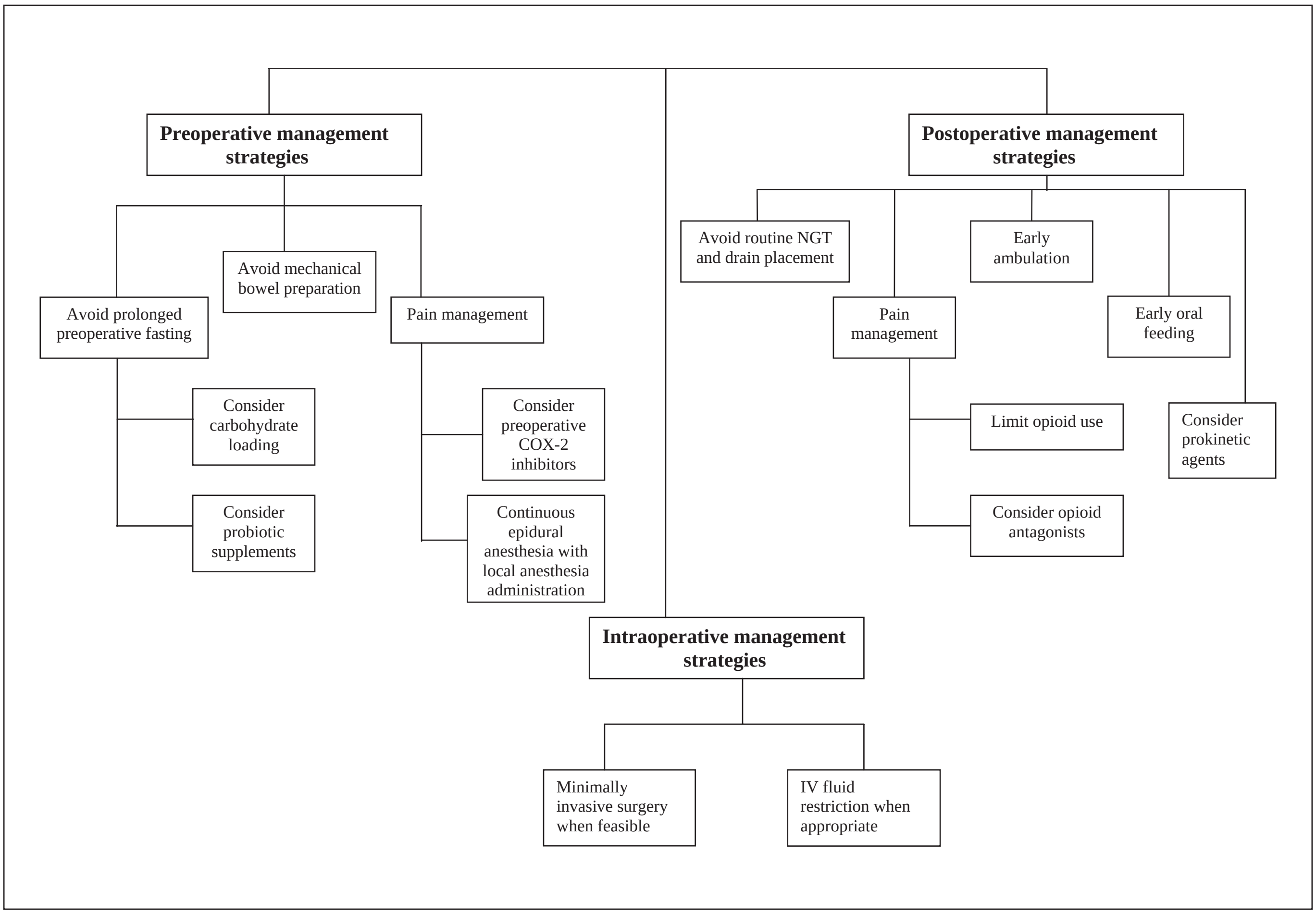

Fig. 2. Prevention and treatment algorithm for POI.

domized to receive either bisacodyl or a placebo following surgery. They found that gastrointestinal recovery was significantly accelerated in the bisacodyl group as there was a difference in time to first bowel movement by 1 day.

POI: A Multifactorial Prevention and Treatment Strategy

In the absence of any single approach that prevents or treats POI, a number of treatment algorithms have been developed which attempt to incorporate the optimal combination of the various strategies reviewed above. Although these algorithms differ in many respects, they all include limiting narcotic use and dose, incorporation of thoracic epidural analgesia with local anesthesia and emphasize early enteral feeding and ambulation (fig. 2).

Several European studies were conducted in which combinations of evidence-based perioperative strategies were instituted in a fast-track approach for patients undergoing abdominal surgery [69, 70]. Fast-track perioperative care included extensive preoperative counseling, avoidance of mechanical bowel preparation and sedative premedication, no preoperative fasting but rather carbohydrate-loaded liquids until 2 h prior to surgery, tailored anesthesia encompassing thoracic epidural anesthesia and short-acting anesthetics, tight perioperative intravenous fluid restriction, minimally invasive surgical approaches when possible, nonopioid pain management, avoidance of routine drains and NGTs, standard laxatives and prokinetics, early and enhanced postoperative feeding and mobilization. In these studies, patients in the fast-track group achieved marked improvements in time to return of normal bowel function and reduced hospital stay compared with patients treated conventionally [71–74]. Importantly, Kehlet and Wilmore [71] point out a shared frame of mind among patients, nurses, physicians and other medical personnel are essential for the implementation of a successful fast-track protocol.

Basse et al. [75] compared 130 patients undergoing colonic surgery utilizing a fast-track protocol, with 130 patients undergoing conventional treatment. They demonstrated a reduced time to bowel movement from 4.5 to 2 days, reduced hospital stay from 8 to 4 days and reduced cardiopulmonary complications in the fast-track group. In a separate study by the same authors, 14 fast-track patients were compared with 14 traditional patients having colonic resection. The fast-track patients reported greater reductions of time to bowel movement and length of stay than conventional patients [76]. Delaney et al. [77] have similarly demonstrated that even in more complex colorectal and reoperative pelvic surgeries fast-track treatment can significantly shorten hospital stay.

Despite the apparent effectiveness of these fast-track approaches and the negative effect of more traditional surgical practices, surgeons have been slow to adopt the new and give up the old. In a survey of clinical practice following colon operations in 295 hospitals throughout Europe and the USA, NGTs were left in situ in 40–66% of cases and preoperative mechanical bowel preps were used in more than 85% of patients [78]. Ileus persisted for more than 5 days in nearly half of these patients and hospital stay was 7–10 days. By these measures, there is still considerable progress to be made in educating today's surgeons and fully implementing steps already known to be effective in ameliorating POI.

Summary

POI is a normal consequence of abdominal and many extra-abdominal surgery. It is characterized by bowel distension, lack of bowel sounds, and a delay in time to flatus and bowel movement. Adverse effects of POI include increased postoperative pain, delay in resuming oral intake, poor wound healing, delayed mobilization, increased risk of pulmonary complications and prolonged hospitalization.

POI also has a substantial economic impact. Based on information from the HCFA database from 1999 to 2000, POI is estimated to increase hospital stay by 5 days [1, 2]. Total hospital costs increased significantly from USD 10,000–16,000 per patient contributing to total extra hospitalization costs of USD 1.14 billion [1]. Similarly, readmission rates for patient were also found to increase from 0.2% in non-POI patients to 3.6% in those with POI [1, 2].

Various strategies to prevent POI and decrease the time needed for postoperative GI motility to return to normal function have been employed and/or are currently being investigated. The use of epidural local anesthetics for postoperative analgesia, when used in conjunction with fast-track perioperative care, has significantly shortened the time to return of normal bowel sounds and bowel movements. There is also clinical evidence that the use of anti-inflammatory NSAIDs and COX-2 inhibitors may help to increase GI motility after abdominal surgery. Finally, new drugs such as alvimopan and methylnaltrexone show promise for preventing POI. Though many of these strategies have been shown to be partially beneficial on there own, when used in combination as part of a fast-track protocol a significant decrease in time to return of normal bowel function and shorten length of hospital stay can be expected.

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