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Review Article

Minimal Invasive Urologic Surgery and Postoperative Ileus

Fouad Aoun[1], Marc Zanaty[2], Alexandre Peltier[1], and Roland van Velthoven[1]

[1] *Department of Urology, Jules Bordet Institute, 1 Héger-Bordet Street, 1000 Brussels, Belgium*
[2] *Université Paris XII, 61 Avenue du Général de Gaulle, 94010 Créteil, France*

Corresponding Author: Fouad Aoun; email: fouad.aoun@bordet.be

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Abstract. Postoperative ileus (POI) is the most common cause of prolonged length of hospital stays (LOS) and associated healthcare costs. The advent of minimal invasive technique was a major breakthrough in the urologic landscape with great potential to progress in the future. In the field of gastrointestinal surgery, several studies had reported lower incidence rates for POI following minimal invasive surgery compared to conventional open procedures. In contrast, little is known about the effect of minimal invasive approach on the recovery of bowel motility after urologic surgery. We performed an overview of the potential benefit of minimal invasive approach on POI for urologic procedures. The mechanisms and risk factors responsible for the onset of POI are discussed with emphasis on the advantages of minimal invasive approach. In the urologic field, POI is the main complication following radical cystectomy but it is rarely of clinical significance for other minimal invasive interventions. Laparoscopy or robotic assisted laparoscopic techniques when studied individually may reduce to their own the duration and prevent the onset of POI in a subset of procedures. The potential influence of age and urinary diversion type on postoperative ileus is contradictory in the literature. There is some evidence suggesting that BMI, blood loss, urinary extravasation, existence of a major complication, bowel resection, operative time and transperitoneal approach are independent risk factors for POI. Treatment of POI remains elusive. One of the most important and effective management strategies for patients undergoing radical cystectomy has been the development and use of enhanced recovery programs. An optimal rational strategy to shorten the duration of POI should incorporate minimal invasive approach when appropriate into multimodal fast track programs designed to reduce POI and shorten LOS.

Keywords: postoperative ileus; minimal invasive; urologic malignancies

1. Introduction

The word ileus is derived from the Greek word ‘eileos’ which means twisted or obstructed. As early as 1906, Cannon and Murphy noticed that ileus was a common and almost inevitable consequence after abdominal surgery [1]. After a century of debate a consensus conference in 2006 defined postoperative ileus (POI) “as a transient cessation of coordinated bowel motility after surgical intervention which prevents effective transit of intestinal contents or tolerance of oral intake” [2]. Although the exact pathogenesis of ileus remains multifactorial and partially elucidated, the clinical picture appears to be transiently impaired intestinal equilibrium, resulting in disorganized electrical activity and paralysis of intestinal segments [3]. Clinically, POI is characterized by bowel distension, absent/hypoactive bowel

sounds, and lack of passage of flatus and stool. Symptoms include nausea, vomiting, poor appetite, inability to tolerate an oral diet, mild abdominal pain, discomfort and bloating. In addition, POI increases the sense of dissatisfaction of the procedure and anxiety about surgical results. It also enhances catabolism because of poor nutrition and immobilization which compromise postoperative recovery by increasing the risk of infection, thrombo-embolism, atelectasis, poor wound healing and the need for nutritional support [4]. Moreover, POI is the most common cause of prolonged length of hospital stays (LOS) and associated healthcare costs after abdominal surgery [5–8]. In 2008, it has been estimated that total hospital costs attributable to POI account for USD 1.28 billion annually in the placecountry-regionUS [9]. Due to its huge economic burden in the current era of declining health care resources, POI has become a health care priority to the surgical community with interventions reducing LOS having great implications both for the individual patient and for hospital resource utilization. Urology is a dynamic surgical discipline, which has undergone many developments and refinements over the past few decades. The advent of minimal invasive technique was a major breakthrough in the urologic landscape and provided an alternative approach to conventional open procedures with a tremendous potential to progress in the future. In gastrointestinal (GI) surgery, several studies had reported lower incidence rates for POI following minimal invasive surgery compared to open procedures [10, 11]. In the field of urology, POI is the main complication following radical cystectomy but it is rarely of clinical significance for other minimal invasive procedures [12]. Prior to 1990, few researches were interested by POI and there were no clinical trials or discussed methods to prevent POI and reduce LOS. Since the early 1990, a number of strategies and regimens to enhance postoperative recovery including bowel preparation, choice of anaesthesia and analgesia, surgical technique, nasogastric tube placement, early ambulation, early oral feeding, visceral learning, laxatives and prokinetic agents have been studied in animal models and clinical practice. Afterwards, these strategies have been incorporated into multimodal fast track programs designed to reduce POI and shorten LOS and several randomized prospective studies and cohort comparison trials had been published. The greatest advance in limiting the duration and severity of POI to date has probably resulted from expanded use of thoracic epidural anaesthesia and laparoscopic surgery with its advantage of limiting tissue trauma and bowel manipulation. The present report is a synthetic overview of the literature to assess the effect of minimal invasive surgery on POI for urologic procedures. Emphasis will also be placed on the pathophsiology of POI and the advantages of minimal invasive approach for prevention of POI. The treatment of POI will also be summarized.

2. Minimal Duration of POI Following Minimal Invasive Surgery: What Is the Concept?

The motility of the GI tract is under the control of several physiologic mechanisms, including the autonomic nervous system, gastrointestinal hormones, and inflammatory mediators [13]. Surgery typically alters the activity of one or more of these modifiers and therefore can have profound effects on bowel motility. Limiting these effects forms the basis of many therapeutic options that are used to improve the severity and to enhance the recovery of POI. Boeckxstaens et al. and Holzer et al. demonstrated that skin incision after laparotomy briefly inhibit GI motility by activation of an adrenergic splanchnic inhibitory afferents pathway [14, 15]. In addition, handling of the intestine and traction on the mesentery results in an additional high-threshold supraspinal inhibitory pathway [16, 17]. Furthermore, acute inflammatory response following surgery correlates well with the extent of surgical intervention and bowel handling [18, 19]. Its effect is not necessarily limited to the manipulated segment as there appears to be an inflammatory field effect affecting the entire GI tract with recovery differing according to each gastrointestinal segment [20-21]. In clinical practice, the true incidence of POI after minimal invasive urologic surgery is not known because of incomplete documentation and inconsistent definition. Furthermore, excluding radical cystectomy, its clinical relevance in other urologic procedure is minimal and often not systematically mentioned in studies reporting complications of laparoscopic or robot assisted laparoscopic urologic surgery. It is noteworthy to mention that the incidence of POI is highest in procedures involving bowel resections such as radical cystectomy with urinary diversion but can occur in extraperitoneal surgeries as well and even in general anaesthesia alone [22]. Moreover, the measurement of postoperative intestinal motility is complex and not performed in routine day to day surgical practice which renders comparison of results more difficult. However, experiments showed that POI is usually transient and resolves in a regular pattern. Peristaltic activity of the small intestine returns after 6–12 h, that of the stomach after 12–24 h and that of the colon after 48–120 h [23]. Peristaltic activity of the colon usually recovers from proximal to distal and is considered the limiting factor in resolving POI [24]. The assumption that minimal invasive surgery is actually associated with a significantly shorter duration of POI is corroborated by both animal experiments and clinical studies. In clinical practice, it had been demonstrated that the duration and severity of POI correlates with the length of incision, extent of opening of the peritoneum, blood loss, hypovolemia, hypothermia, exposure time of intra-abdominal contents to the external environment, experience of the surgeon and total opiate dose [25–31]. The main advantages of minimal invasive approach include better cosmetic results, less blood loss, decreased postoperative pain, faster functional recovery, and a shorter LOS [32]. In addition, the return of gut function is faster compared to open surgery [33]. The latter benefit stems from a decreased

need for retraction and dissection, lack of exposure of the viscera to room air, smaller-access incisions, gentle tissue handling and less bowel manipulation. Furthermore, minimal invasive surgery for intra-peritoneal procedures is performed through small openings in the parietal peritoneum [31]. Good magnified visual field, reduced tissue trauma and high pressure limit blood loss which is associated with a prolonged POI in clinical studies [31]. Prolonged surgical times had been reported with some laparoscopic procedures but there is no evidence to suggest that the duration of surgery negatively affects the duration of POI and, accordingly, surgical duration should not come at the cost of meticulous and minimally traumatic surgical technique. Decreased surgical site pain and incision pain are also well-established benefits of minimal invasive surgery [34]. Effective post laparoscopic or robot assisted laparoscopic analgesia may be obtained with simple analgesics avoiding the use of opiates which could potentiate POI after minimal invasive radical cystectomy [35]. The use of local anaesthetics infiltrated subcutaneously into the surgical wound also appears to have a similar beneficial effect, although this effect appears to be limited to laparoscopic incision sites only [36]. Similarly, reduced inflammatory and catabolic responses in laparoscopic approach may also result in early recovery after operation [37]. Less pain combined with early recovery allows early ambulation witch is a major component of most multimodal fast track approaches [38]. Understandably, minimal invasive approach is considered to reduce severity and duration of POI resulting in shorter length of stay in hospital.

3. Positive Clinical Impact for Minimal Invasive Surgery on POI: What Is the Evidence?

The first studies reporting favourable outcomes for POI after minimal invasive approach compared to conventional open approach was published > 20 years ago. The authors concluded that POI was clinically non existent after laparoscopic cholecystectomy compared to open cholecystectomy [40]. Similarly, in a recent Cochrane meta-analysis of 54 randomized clinical trials comparing laparoscopic versus open appendectomy, LOS was significantly shorter by 1.1 day with a substantial reduction in health care costs in the laparoscopic group [41]. In contrast, the data comparing the duration of POI after laparoscopic and conventional colorectal resections are contradictory with a trend toward lower incidence of POI in favour of minimal invasive approach [42–47]. In the field of urologic surgery, POI is the main complication following radical cystectomy (RC) with urinary diversion with reported incidence varying among different studies from 1.58 to 25.5% [12, 35, 47]. This disparity is due to variable definition of POI encountered in the literature, different operation techniques and approach, and variable perioperative management in contemporary series. There are also multiple identifiable risk factors for the development of POI that vary according to the studied population and the specific procedure. In a systematic review identifying 13 793 patients who underwent radical cystectomy with urinary diversion the average rate of POI was 9.86% [12]. In this review, minimal invasive radical cystectomy was associated with faster GI recovery when compared with the conventional open procedure with a probable advantage of robotic assisted approach over laparoscopic approach [12]. Closure of the peritoneum in robotic assisted laparoscopic radical cystectyomy was found to hasten the return of bowel function [48]. Older age and higher body mass index (BMI) were independent risk factors for POI in an observational cohort study [49]. The latter finding was reported also by Lee et al. [50]. In addition to increasing age and BMI, Hollenbeck et al noted a history of dyspnea, general anaesthesia, and increasing operative time to be risk factors for the development of POI [51]. However, other authors found no significant difference in POI among patients >80 yr of age compared with patients <80 yr in a cohort of radical cystectomy patients [52]. Chang et al. demonstrated that ethnic minority, the existence of another major complication, and blood loss >600 ml were all significantly related to POI [53]. The potential influence of urinary diversion type on POI rates is contradictory with some authors reporting higher incidence for their ileal conduit patient compared to the ileal neobladder group while others did not observe any difference in POI incidence between ileal conduit, Indiana pouch, and neobladder in their series [54, 55]. In a retrospective case series analysis, POI was reported in 19% of patients undergoing cystectomy with cutaneous ureterostomy [56]. Presence of urine around the intestines was reported to be a risk factor for POI. Stenting of the uretero-ileal anastomosis allows for significant early recovery of bowel activity by reducing the risk of urinary leak [57].

The incidence of POI is lower in other urologic procedures with no bowel resection. POI in laparoscopic radical prostatectomy and robotic assisted laparoscopic prostatectomy ranges from 0 to 5% in the literature [58, 59]. Risk factors include extensive bowel mobilization and adhesiolysis, postoperative bleeding and urinary extravasations for the transperitoneal approach [60]. There are no studies assessing the incidence of POI in extraperitoneal minimal invasive radical prostatectomy. Minimal invasive total and partial nephrectomy are rarely associated with POI. In a recent meta-analysis, although the authors did not report on the incidence of POI between the two groups, retroperitoneal approach for total and partial nephrectomy was associated with less intraoperative blood loss, shorter time to first ambulation and shorter LOS compared to transperitoneal laparoscopic approach [61]. Similarly, several non randomized non-concurring cohort studies demonstrated longer POI for the transperitoneal approach [62, 63]. Consequently, depending on the approach, the incidence of POI varied between 0 to 6% [64]. In robotic partial nephrectomy, the incidence was < 1% and higher incidences were reported if urine leakage occurs postoperatively [65].

4. Prevention and Management of POI Following Urologic Minimal Invasive Procedures

Several strategies have been developed to prevent the onset of POI or to hasten its recovery. These strategies could be regrouped into three categories: preoperative, intraoperative and postoperative. Mechanical and antibiotic bowel preparation is a vigorous preoperative mechanical cleansing of fecal matter and secretions from the intestines, previously purported to reduce the risk of infectious complications and anastomotic leakage [66]. This was thought to be accomplished through reduction of fecal mass and decreased bacterial count in the bowel lumen [67]. However, recent literature suggests no significant benefit from preoperative bowel preparation for bowel surgery [68]. Several meta-analyses have examined the role of mechanical bowel preparation and no significant benefit has been found with the addition of bowel preparation regarding rates of anastomotic leakage or abdominal abscess [66, 68, 69, 69, 70]. Literature regarding elimination of mechanical bowel preparation in minimal invasive urologic surgery is limited. Most of the studies evaluated mechanical bowel preparation in patients undergoing cystectomy and urinary diversion without specific attention to the surgical approach. Raynor et al. compared two cohorts of patients undergoing radical cystectomy and urinary diversion [71]. The first cohort of patients received a preoperative mechanical bowel preparation including a clear liquid diet, magnesium citrate solution, and an enema before surgery. The second cohort of patients was given a regular diet before surgery and did not undergo a mechanical bowel preparation except for the enema before surgery. They demonstrated no significant advantage in perioperative outcomes including the duration of POI following preoperative mechanical bowel preparation. In their studies, approximately one-half of patients in each group underwent robotic approach to cystectomy. The authors stated that there were no subjective difficulties identified intra-operatively to suggest any benefit of preoperative bowel preparation for a laparoscopic or robot-assisted approach. Moreover, preoperative mechanical bowel preparation may have potential unfavourable consequences on bowel motility, electrolytes balance, and microbial colonisation of the intestines [72]. Similarly, an analysis of a Japanese national database demonstrated the safety to omit mechanical bowel preparation before laparoscopic prostatectomy and laparoscopic nephrectomy [73, 74]. The use of rectal enema prior to the surgical procedure had no influence on POI but could be beneficial because it decreases rectal distension and facilitates the development of the pre-rectal space during radical cystectomy or radical prostatectomy, especially in the minimal invasive assisted approach. Fasting before urologic surgery had not shown to decrease the duration of POI and a more liberal attitude is currently being recommended before minimal invasive approach [75, 76]. Intra-operatively, a carefully designed fluid management strategy is mandatory to fasten the recovery of POI by avoiding hypovolemia and hypotension [77]. In addition, optimization of intra-operative fluid management has been associated with an optimization of fluid balance within the splanchnic vasculature which further enhances circulatory regulation to the gut mucosa and was associated with faster recovery of intestinal gut motility [78–82]. By avoiding systemic morphine administration, thoracic epidural anaesthesia for minimal invasive urologic surgery is a good alternative for intra-operative as well as post-operative pain management and had shown to decrease POI in clinical practice [47, 83, 84]. Post-operatively, based on the available evidence, gum chewing and early ambulation are simple minimal risk measures that could potentially help recovery of POI [85–88]. Additionally, reducing the use of nasogastric tubes postoperatively has been shown to be safe. Previous studies have shown no improvement in outcomes with the routine use of nasogastric tubes [12, 89–91]. Opioid use has been shown to exacerbate POI via the activation of a peripheral μ-opioid receptor on the gastrointestinal tract and thus should be avoided [92]. However, in day to day urologic practice, it is difficult to control pain without the use of opioid in the absence of multimodal pain regimen and epidural anaesthesia especially for radical urologic procedures [93–95]. Nonsteroidal anti-inflammatory drugs especially after radical urologic surgeries are attractive alternatives to opiate analgesics, both for their anti-inflammatory effect and for their opiate sparing properties. However, they can cause bleeding, renal insufficiency, and gastritis, drawbacks that limit their applicability and duration of use [96]. Alvimopan is an oral selective antagonist of the μ-opioid receptor that does not cross the blood-brain barrier due to its physico-chemical properties, therefore blocking the action of opioid on peripheral receptor without interfering with opioid central analgesia [97]. In a multicentre randomized placebo-controlled trial, patients receiving alvimopan after radical cystectomy experienced quicker bowel recovery and had a shorter hospital stay compared with those who received placebo, with comparable safety [98]. The cost-effectiveness of alvimopan is influenced by the POI incidence and the degree to which the drug can decrease the LOS [99].

5. Conclusion

POI is a major health problem for which efficient treatment remains elusive. Prevention is the principle key factor to avoid POI and its potential complications. Laparoscopy or robotic assisted laparoscopic techniques when studied individually may reduce to their own the duration and prevent the onset of POI in a subset of procedures. One of the most important and effective management strategies for patients undergoing radical cystectomy has been the development and use of enhanced recovery programs. These programs represent an important process innovation in patient management and have been shown to be effective in standardizing care, reducing costs, reducing errors, and, most important, improving patient outcomes. An optimal rational strategy

to shorten the duration of POI should incorporate minimal invasive approach when appropriate into multimodal fast track programs designed to reduce POI and shorten LOS.

Conflict of interest

The authors declare that they have no conflict of interest.

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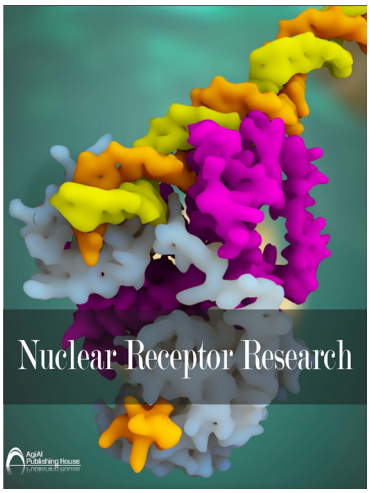

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