PERIOPERATIVE PAIN CONTROL IN GASTROINTESTINAL SURGERY


Abstract:

Perioperative pain control in the setting of gastrointestinal surgery presents unique challenges for the clinician, including the incidence of ileus and its potential exacerbation by analgesics, large incisions, patient characteristics and a wide variety of other factors. At the same time, optimizing postoperative pain control is of key significance in this patient population and has implications for both medical and surgical outcomes, length of hospital stay and associated costs and risks of developing chronic postsurgical pain. Data from recent clinical trials and other studies have highlighted the impact of specific surgical and anesthetic techniques on post-operative pain for several types of abdominal surgeries, including pancreatoduodenectomy, hepatectomy, gastric bypass, cholecystectomy, colectomy, and appendectomy. The management of pain may be optimized through the multidisciplinary and concerted efforts between clinicians involved in the perioperative care of patients undergoing gastrointestinal surgery.

Introduction

The incidence of gastrointestinal surgery in both the inpatient and outpatient settings has been increasing steadily in recent years, likely due to the increasing aging population of the United States. Large abdominal procedures, such as pancreatic, liver, and bariatric procedures, continue to comprise a large proportion of the clinical case volume in academic medical centers. Effective management of perioperative pain in gastrointestinal surgery is a primary consideration in terms of improving patient recovery time, length of hospital stay and patient satisfaction.

Postoperative pain continues to be a barrier to successful recovery and rehabilitation after surgery. One study estimates that roughly 75% of postoperative patients experience moderate to severe postoperative pain, often due suboptimal analgesic therapy1. In addition to problems discovered while the patients remain in the hospital, such as delayed wound healing and respiratory distress, acute-postsurgical pain is widely accepted today as a risk factor for the development of long term psychological distress and chronic postsurgical pain2.

Gastrointestinal surgery has a particularly high incidence of both postoperative pain and gastrointestinal symptoms, such as nausea, vomiting and the development of ileus. These

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gastrointestinal symptoms are frequently related to the preoperative diagnosis or surgical interventions; however, some analgesic medical therapies, such as commonly used opiates, are also known to contribute to nausea and vomiting. For this reason, optimizing perioperative pain control in the setting of gastrointestinal surgery presents unique challenges for the clinician in this particular subset of surgical patients.

Several studies and meta-analyses have looked at variable surgical techniques in order to investigate whether factors such as laparoscopic port size and number, insufflation pressures, use of local anesthetics, and various other surgical variables have any significant impact on postoperative pain and recovery. In addition, many recent studies have investigated different modalities of pain control, including epidural and intrathecal administration routes, and their role in improving postoperative pain compared to more traditional, intravenous medications.

Much attention in the literature has recently focused on the importance of perioperative pain control, in particular the concept of preventative analgesia. Preventive analgesia encompasses the use of various modalities before, during and after surgery to minimize postoperative pain and recovery. For example, preoperative epidural administration of local anesthetics and opioids or the performance of a nerve block to provide anesthesia in the anatomical distribution of the surgical procedure. In fact, such pre-incision therapies have been shown to help prevent the development of altered processing of afferent neuronal pain input, which would otherwise heighten postoperative pain. This is one of the concepts supporting the practice of multimodal analgesia, utilizing different types and routes of analgesic therapy in order to manage postsurgical pain.

This review article summarizes the literature detailing the impact of different surgical and anesthetic techniques on post-operative pain for several types of gastrointestinal surgeries, including pancreateoduodenectomy, hepatectomy, gastric bypass, cholecystectomy, colectomy, and appendectomy. In addition, this review also highlights the need for increased attention and comparative outcome studies addressing perioperative pain management after gastrointestinal surgery.

**Pancreateoduodenectomy**

Pancreateoduodenectomy, or Whipple procedure, is performed to treat cancerous tumors located in the pancreas, bile ducts, and duodenum. By removing portions of the stomach, gallbladder, pancreas, and duodenum, the surgeon reattaches the pancreas to the jejunum to allow food and gastrointestinal juices to empty. Although there is wide variation among centers and particular surgeons, the procedure typically involves a moderate to large size abdominal incision which contributes to significant post-operative pain. Numerous recent studies have focused on the effects of intravenous (IV) versus epidural analgesia. Epidural catheters have been found to provide better pain relief than IV analgesic medications. They have been associated with a significantly decreased risk of postoperative pneumonia and insulin resistance, while improving pulmonary function and arterial oxygenation, and decreased hospital time.

In particular, thoracic epidural anesthesia has been demonstrated to improve post-operative pain in major abdominal surgeries and has also been associated with decreased rates of post-operative pneumonia and even insulin resistance. As such, it has become a standard approach to post-operative pain control in patients undergoing pancreatic and other major abdominal surgery. However, there are instances in which the procedure is contraindicated, for example, in the setting of coagulopathy. Other studies have suggested that it may increase the risk of hemodynamic instability and compromise to enteric anastomoses, intestinal perfusion and recovery of bowel function. A number of gastrointestinal complications, including ileus, biliary leakage, and bleeding, have been shown to increase with epidural use. The fluid shifts that occur during epidural use can lead to an increased risk of intensive care unit admission. Likewise, up to one-third of epidurals may not function satisfactorily due to poor insertion levels, insufficient local anesthetic/opioid dosages, or pump failure. Since, the use of epidural analgesics seem to decrease hospitalization time and control pain effectively,
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More evidence has been building in favor for its use. Additional studies on epidural use in laparoscopic pancreatic resections are necessary, as not all situations allow for its use.

The most common alternative to post-operative pain control is patient controlled analgesia (PCA), in which intravenous opioid therapy may be administered in increments based on patient preferences. Another alternative is intravenous infusion of lidocaine. In a systemic review of 8 trials, there was a decrease in the duration of ileus, length of hospital stay, post-operative pain and post-operative nausea and vomiting with intravenous lidocaine infusion compared to PCA morphine.

Further, ultrasound guided transversus abdominis plane (TAP) block has been shown to provide anesthesia to the anterolateral abdominal wall. Although there are no studies comparing TAP blocks to epidurals and other modalities of post-operative pain control, a recent meta-analysis of randomized controlled trials found the procedure to reduce opioid requirements and opioid-associated side effects, in addition to improving pain relief compared to patients who did not receive a TAP block as part of the perioperative pain management plan.

The surgical techniques utilized in pancreatic surgery have also been found to impact postoperative pain. Minimally invasive surgery has been the desired method of surgery in recent years, as it tends to reduce postoperative pain, increase patient mobility, increase recovery rates, and provide a better cosmetic appearance. A recent retrospective analysis compared outcomes between patients undergoing hybrid laparoscopy-assisted pancreatectoduodenectomy (HLAPD), in which pancreatectoduodenal resection is performed laparoscopically while reconstruction is completed via a small upper midline minilaparotomy, and open pancreatectoduodenectomy (OPD). The HLAPD demonstrated not only a significantly lower estimated intraoperative blood loss and a shorter length of hospital stay, but also the HLAPD tended to have lower analgesic requirements. Twelve (92%) patients in the HLAPD group used an epidural for postoperative pain control compared with 19 (95%) patients in the OPD group. Mean 7-day analgesic requirements were lower in patients who underwent HLAPD than those who underwent OPD (174 mg v. 288 mg), though this trend did not achieve significance ($p = 0.08$). Therefore, in addition to medical and anesthetic variables contributing to improved postoperative pain, novel and less-invasive surgical techniques also may impact postoperative pain in patients undergoing pancreatectoduodenectomy. However, further research is warranted, particularly larger and multi-centered comparative randomized trials evaluating postoperative pain between open versus minimally invasive techniques may help further define its role in improving postoperative pain outcomes.

**Hepatectomy**

A partial hepatectomy can refer to the resection of hepatic tissue from a diseased liver, either due to benign or malignant neoplasms, metastases, gallstones or parasitic cysts. As in the case of pancreatectoduodenectomy, hepatectomies can frequently involve wide upper abdominal incisions, contributing to post-operative pain control and affecting recovery time.

The risk of coagulopathy after liver resection surgery has made the placement of epidurals controversial. Although no cases of epidural hematoma formation have been linked to liver resection, catheters are often not removed before coagulation studies return to normal postoperatively. Even at 7 days postoperatively, the prothrombin time (PT) may be as prolonged as long as 22%. Further, 7-8% of catheters can be expected to spontaneously dislodge during use, and 50% of epidural hematomas occur as a result of catheter removal. Previously, an INR of 1.4 was considered the highest safe value for removal of an epidural catheter. A large prospective study in patients with epidurals and demonstrated that epidural removal with INRs higher than 1.4 did not result in any epidural hematoma formation of over 4,000 patients. This may not be generalizable to all liver procedures. In the study, patients were on warfarin, which selectively inhibits the vitamin K-dependent coagulation factors. Therefore, the use of epidurals has been demonstrated to be safe with a certain degree of coagulopathy, and it has been studied extensively in its role on postoperative pain after liver surgery.
A working epidural provides excellent pain control for liver resection. However, one study found that 20% of epidurals in one study did not function or functioned poorly. Intrathecal morphine has been used as a substitute for epidural analgesia with mixed results. Some studies have demonstrated a higher rate of rescue parenteral opioid analgesia with intrathecal morphine. Others have attempted to demonstrate adequate pain relief with intrathecal morphine and gabapentin compared with epidural analgesia. However, use of other analgesic modalities such as NSAIDs and systemic opioids has made the results unclear. Interestingly, patients treated with their regimen of intrathecal morphine and gabapentin pre- and postoperatively ate 4 hours earlier on average and were discharged 1.9 days earlier than patients in the epidural group.

Another modality utilized for post-operative pain control after hepatic surgery is infusion of local anesthetic via the On-Q Pain Buster, which can continuously deliver local anesthetics for up to five days. In one study involving forty-eight patients scheduled for elective liver surgery, the treatment group received ropivacaine 0.25% infusion at 4 ml/hr for 68 hours via two multi-orifice indwelling catheters placed within the musculo-fascial layer before skin closure along with morphine PCA. Compared to the control group receiving saline infusion, the ropivacaine group had decreased morphine requirements and improved post-operative pain relief. An infusion of no more than 0.25% ropivacaine or duration of infusion of less than 2 days is recommended due to concerns of increased plasma levels post hepatectomy. In a recent prospective, randomized study forty adult living liver donors were assigned to receive either intrathecal morphine along with intravenous fentanyl or 0.5% ropivacaine via a multi-orifice catheter (On-Q Pain Buster) placed at the wound. While analgesia was less effective in the first twelve hours after surgery in the Pain Buster group and comparable in later hours, patients in the Pain Buster group had shorter bowel recovery time. Local anesthetic infusions through the Pain Buster, therefore, represent an appealing alternative to epidural, intravenous and intrathecal methods of post-operative pain control after liver surgery.

Recently, several surgical approaches have evolved for liver resections, including totally laparoscopic, hand-assisted, and laparoscopic-assisted open “hybrid” techniques. These surgically techniques, which are less invasive than standard open approaches, tend to be associated with less operative blood loss, less postoperative pain and analgesic requirements, and a shorter length of hospital stay, with comparable postoperative morbidity and mortality to open liver resection. Therefore, surgical technique along with anesthetic approaches, have significant impacts on perioperative pain control in liver surgery.

**Gastric Bypass Surgery:**

There are approximately 9 million morbidly obese (BMI of 40 or above) individuals in the United States. Obesity predisposes individuals to a variety of health factors throughout their lives. Cases of morbid obesity are rising in the United States, with an estimated 300,000 deaths attributed to complications of the disease annually in the United States. Gastric bypass, a type of bariatric surgery to treat obese, morbidly obese, or super-obese patients, typically divides the stomach into an upper and lower pouch that, when reconnected to the small intestine, reduces the functional volume of the stomach and amount of food stored. In this particular type of surgery, the effects of surgical technique and multimodal pain management interventions on postoperative pain have been studied extensively.

Obesity presents unique challenges to the clinician with regard to controlling pain and respiratory and hemodynamic stability perioperatively when bariatric surgery is performed. Obese patients may be more sensitive to the respiratory depressant effect of opioid analgesic drugs and are more likely to require postoperative ventilation to avoid hypoxic episodes. Patients that were placed on continuous low dose ketamine infusion (1lg/kg/min) with remifentanil and propofol infusion (TIVA) for laparoscopic Roux-en-Y gastric bypass (LRYGB) had decreased pain scores, morphine PCA consumption, and better hemodynamic stability than a combination of remifentanil-propofol alone. This may be due to ketamine’s activation of descending pain inhibitory mono-aminergic pathways.
to produce anti-nociception. Likewise, the use of 0.5% IP bupivacaine during LRYGB compared to saline alone reduced overall postoperative opioid consumption. However, other outcome variables, including length of stay and VAS scores, showed no significant difference.

Laparoscopic procedures require insufflation of the abdomen with carbon dioxide in order to enhance the visual field and facilitate instrumentation. One study looked at whether different values of intra-abdominal pressures had an impact on postoperative visceral type pain. Patients were randomized into low pressure (8 mmHg), standard pressure (12 mmHg), and high pressure (14 mmHg) groups. However, when comparing these groups based on age, weight, and analgesic consumption, no statistically significant difference was found, suggesting that insufflation pressures did not have a major impact on postoperative visceral pain.

Several recent studies have investigated the role of multimodal approaches to the management of perioperative pain in patient scheduled for obesity related surgery, such as gastric bypass. In a study of 114 patients undergoing gastric bypass surgery, patients were randomized to incisional local anesthetic infiltration plus post-operative PCA (Group A), epidural anesthesia and analgesia (Group B) or post-operative PCA (Group C). The authors demonstrated lower pain scores in Group A than in Groups B or C when measured 0, 12 and 36 hours in the post-operative period, thereby demonstrating that a multimodal approach—including incisional local anesthetic to more conventional modalities such as PCA—can result in optimized post-operative pain control. A recent retrospective analysis attempted to compare traditional approaches to pain management in obese patients undergoing various bariatric surgeries, including laparoscopic Roux-en-Y gastric bypass and laparoscopic adjustable banding to a multidisciplinary approach. Karlnoski and colleagues demonstrated that compared to standard ketorolac and morphine PCA for pain control, an interdisciplinary approach with ketorolac, hydromorphone PCA and bariatric team consisting of a psychologist, exercise physiologist and nutritionist, significantly improved pain control in post-operative days one through five. Thus, bariatric surgery is one area of gastrointestinal surgery that has been studied that demonstrates the benefits of both multimodal therapy and multidisciplinary approaches to post-operative pain management.

Cholecystectomy

Cholecystectomies, of which more than 750,000 are performed annually in the United States, are performed for a wide variety of reasons, most commonly as treatment for cholecystitis, biliary colic and cancer of the gallbladder. Although most commonly performed laparoscopically, pain continues to be a significant barrier to discharge during the postoperative course.

Epidural analgesia is seldom used for the treatment of post-cholecystectomy pain, but it is a feasible option. One group investigated the feasibility of epidural analgesia for laparo-endoscopic single-site cholecystectomy (LESS) in a 20-patient cohort. Patients receiving epidural analgesia had lower pain scores on a visual analogue scale (VAS) score than patients receiving general anesthesia and were able to be discharged on the day of surgery. Patients in the epidural group had higher rates of shoulder pain but less nausea and vomiting. These findings were not statistically significant. Interestingly, patients remained spontaneously breathing during epidural anesthesia, and did not have adverse respiratory outcomes or impaired respiration as evidenced by arterial blood gas analysis. Another study found that open cholecystectomy pain was better managed with epidural analgesia than IV analgesia. Although both groups had similar numbers of patients discharged within 36 hours, only 4.1% of epidural patients required additional analgesia, compared with 29.4% in the IV group. Nausea was also significantly lower in the epidural group than in the IV group. These findings, however, are in contrast to a group that investigated epidural versus general anesthesia for laparoscopic cholecystectomy in elderly patients at a single hospital. They found that analgesia was that same in both groups, but that patient satisfaction was higher in the general anesthesia group, which was attributed to the discomfort associated with the epidural placement.

In the United States, most cholecystectomies are performed...
performed laparoscopically with small incisions, and for this reason epidural analgesia has played a smaller role in management of postoperative pain. However, when an open cholecystectomy must be performed, or if the cholecystectomy is a component of a larger abdominal surgery, epidural analgesia is more often considered. In these cases, epidural analgesia is considered, as it has been found to be associated with fewer pulmonary and cardiac complications compared with patient-controlled opioid analgesia in patients undergoing laparotomy. Based on a meta-analysis of patients undergoing thoracic and abdominal surgery, those who received an epidural had an odds ratio of 0.54 of developing pneumonia when compared with patients receiving parenteral, oral, or intramuscular opioids. Epidurals also decreased the odds of prolonged ventilation and reintubation. In addition, the odds of myocardial infarction were decreased in their study, odds ratio 0.55, NNT 48. They also determined that as pulmonary complications of surgery decreased with time, this difference had become smaller in subsequent trials.

Several recent studies have demonstrated improved post-operative pain control after cholecystectomy utilizing agents that function to modulate GABA, a neurotransmitter whose activation has been linked to dampening of the response to painful stimuli. One such medication is pregabalin, a GABA analogue used as an anticonvulsant and treatment for neuropathic pain. In a randomized controlled trial involving patients undergoing laparoscopic cholecystectomy, administration of pregabalin 600 mg orally, divided in two preoperative doses, significantly reduced post-operative pain and opioid requirements, however did lead to greater incidence of dizziness. Gabapentin, a GABA analogue used widely in the treatment of neuropathic pain, is another medication which has recently been shown to improve post-operative pain specifically in patients undergoing laparoscopic cholecystectomy. In a randomized controlled study, patients receiving Gabapentin 300 mg two hours before laparoscopic cholecystectomy were found to have significantly lower postoperative pain and fentanyl requirements when compared to subjects receiving tramadol 100 mg or placebo.

Surgical technique has also been studied with regard to its effects on postoperative pain after cholecystectomy. One study investigated whether active aspiration of subdiaphragmatic gas verses simple evacuation reduced pain after laparoscopic cholecystectomy. Study outcomes were based on postoperative analgesic requirement and level of abdominal and shoulder pain after 24 hours. Investigators found that the simple evacuation group had higher use of analgesics and experienced more abdominal and shoulder pain than the active aspiration group. Additionally, the use of warm, humidified insufflation was found to reduce pain after laparoscopy. These conclusions were drawn from seven randomized controlled studies on adults undergoing elective laparoscopic cholecystectomies in which the exposure groups had warm, humidified insufflation and the control groups had standard, cold dry carbon dioxide. The group exposed to warm, humidified insufflation had lower pain scores on the VAS and decreased morphine usage. All of these studies suggest that modification of the surgical technique with respect to insufflation can significantly impact postoperative analgesia.

Another study investigating surgical technique and postoperative pain in cholecystectomies demonstrated that the number of ports had a significant impact on postoperative pain and analgesic requirements. In the prospective trial, patients were randomized to undergo elective surgery with either the conventional 4-port laparoscopic cholecystectomy or a single-port cholecystectomy. After surgery, postoperative pain on a visual analogue scale and analgesic use were measured, and the single port group had significantly lower pain scores and analgesic use (9 of 24 in single port group versus 19 of 25 in the four-port group; P = 0.007). Similar conclusions were found in another study that compared a new surgical technique of a single incision laparoscopic colectomy with a conventional multiple incision colectomy. Patients in the single incision group had lower pains scores, shorter hospital stays, and improved cosmetic outcomes.

Furthermore, another study examined whether the port location that was used for gallbladder removal had any impact on postoperative pain scores. Over a six-month period, adult patients who were scheduled to undergo elective laparoscopic cholecystectomies
were randomized into two groups: those who had gallbladder retrieval through the epigastric port and those who had it through the umbilical port. Those who had gallbladder removal from the umbilical port were found to have less pain after 24 hours.40

Finally, another modality of surgical technique that has been studied with regard to postoperative pain outcomes is intraperitoneal administration of local anesthesia (IP-LA) either during or after laparoscopic cholecystectomy. A meta-analysis of IP-LA on postoperative abdominal pain outcomes in laparoscopic cholecystectomies reports a significant improvement in 50% of the cases and a quicker hospital discharge. Local anesthesia resulted in a smaller reduction in pain when a PCA was also used.41 Perioperative pain control during cholecystectomy, therefore, appears to have the potential to be optimized by a wide variety of analgesic and surgical techniques.

**Colectomy**

More than 250,000 colorectal resections are performed annually in the United States, and up to 35% of these will develop a complication. Colorectal surgeries encompass vein inflammation (hemorrhoids), fissures, fistulas, cancers, and inflammatory bowel disease. Postoperative pain is a major contributor to increased hospitalization, morbidity and patient satisfaction after colorectal surgery.

As in other gastrointestinal surgeries, the effect of epidural analgesia on postoperative pain after colorectal surgery is a subject of several recent studies. A recent meta-analysis of colorectal surgery patients demonstrated that epidural placement was associated with improved analgesia as judged on a visual analogue scale when compared with parenteral opioid analgesia.42 Postoperative ileus was 36 hours shorter on average in the epidural groups with the exception of one study included in the analysis. However, the primary outcome of the study was length of hospital stay, which was not different between the two groups. Not surprisingly, higher rates of urinary retention, arterial hypotension, and pruritus were found in the epidural group. The study did not find a difference in anastomotic leakage rates regardless of the type of postoperative analgesia.43

The utilization of epidural analgesia in colorectal surgery, however, is controversial due to possible effects on postoperative bowel function. Epidural analgesia invariably leads to increased fluid loading due to the associated hypotension, which appears to have an impact in bowel procedures. One study demonstrated an increased length of stay in patients that received higher amounts of fluid during elective colon surgery. Gastric emptying was delayed for solid and liquids 56 and 52 minutes, respectively, in the group who received liberal amounts of fluid versus a group who had their fluids restricted.44 However, in one study, when patients received intrathecal pain management (which acts neuraxially like epidural analgesia), hypotension developed but was not managed with fluid administration. These patients were compared to those not receiving intrathecal therapy and there was no observed difference in return of bowel function or postoperative complications.45 Another meta-analysis came to the conclusion that epidural local anesthetics led to improved pain control as well as faster return of bowel function than opioids, whether administered systemically or epidurally.46 Postoperative ileus was shorter in patients receiving epidural analgesia; however, prolonged ileus, defined as first bowel movement after postoperative day 7, occurred with equal frequency.47 Patients with prolonged ileus were more likely to have multiple comorbidities. In this study, as well as others, time to hospital discharge was not decreased in patients receiving epidural analgesia.

Surgical technique has also been studied with respect to effects on postoperative pain after colorectal surgery. Studies have found that colonic motility and patient condition improve more rapidly following laparoscopic assisted sigmoid colectomy (LASC) compared to an open procedure, although there were no differences in nausea, bowel sounds, or abdominal pain.48 Another study compared a new surgical technique of a single incision laparoscopic colectomy with a conventional multiple incision colectomy. Patients in the single incision group had lower pain scores, shorter hospital stays, and improved cosmetic outcomes.39 Perioperative pain control during colectomy, therefore, appears to have the potential to be optimized by a wide variety of analgesic and surgical techniques.
Appendectomy

The laparoscopic appendectomy is one of the most common procedures performed in the United States, for acute appendicitis and on an emergent basis in the setting of abscess or peritonitis. With over 270,000 appendectomies performed annually in the United States, postoperative pain control represents a significant barrier to discharge and patient satisfaction.

As in other gastrointestinal surgeries, surgical technique may impact postoperative pain. Conventional laparoscopic appendectomies are performed using 10-mm sized ports; however, there has been a recent increase in use of smaller laparoscopic scopes, including 5- and 2-mm sizes. While smaller ports may lead to less postoperative pain, there are significant limitations to their use. These ports can limit the CO₂ flow rate and lessen the ability to coagulate during instances of bleeding. Studies have demonstrated that those patients of increasing age or with a history of abdominal surgeries may be predisposed to requiring larger ports.

A surgical technique being studied is the use of a single-port laparoscopic approach. The primary advantage of single-port laparoscopic appendectomy (SPLA) is that it requires only a single incision at the umbilicus, which reduces incisional pain and creates better cosmetic effects without the need for open and invasive techniques. Conventional laparoscopy, which uses 3 ports, tends to have longer operative times and less desirable perioperative outcomes compared to SPLA.

Since the vast majority of appendectomies performed in the United States are done laparoscopically with small incisions, the use of epidural analgesia is very rate. Interestingly, Bupivacaine, which is often administered via an epidural injection to reduce postoperative pain in surgical procedures, was studied in the form of wound infiltration to reduce postoperative pain after appendectomies. The use of preincisional 0.5% bupivacaine infiltration in single-incision laparoscopic appendectomy (SILS-A) was found to reduce postoperative pain compared to the conventional laparoscopic approach. Therefore, variables in surgical technique and analgesic modalities have impacts on the optimization of perioperative pain control for appendectomy.

Conclusion

Postoperative pain is widely considered a significant public health concern in the United States and abroad and its under-treatment impacts morbidity, patient satisfaction and hospital costs significantly. Poorly managed perioperative pain can lead not only to suffering in the immediate postoperative period, but has also been shown to contribute to the development of long term psychological distress and even chronic, postsurgical pain requiring medical attention well beyond the perioperative period [Cohen 2013].

Surgeries of the gastrointestinal tract present unique challenges to the clinician in both preventing and managing post-operative pain. Surgical techniques, the necessity of larger incisions and the possibility of surgically related ileus complicate both the prevention and management of pain. In addition, there exists great variability in the timing and types of analgesic therapies that may be utilized to help manage pain throughout the entire perioperative period. Though much research has been devoted in the past several years to addressing possible surgical, medical and anesthetic techniques to improve postoperative pain in general, there is a dearth of literature on pain management addressing the specific challenges encountered in gastrointestinal surgery.

Given the high prevalence of gastrointestinal surgeries, and the potential for increased incidence along with the aging of the United States population, further outcomes and comparative research studies in perioperative pain control specifically addressing these procedures are warranted. Based on available evidence, it is clear that both surgical and analgesic variables may impact pain control. In particular, there is consistent evidence supporting the practice of less invasive surgical manipulation and the utilization of epidural analgesia for certain types of gastrointestinal procedures. The role of multimodal analgesia, with medications and interventions used together, also appears to optimize perioperative pain control in certain types of gastrointestinal surgeries. Nevertheless, large randomized controlled studies are warranted to help further elucidate the role of novel multimodal approaches to perioperative pain control in gastrointestinal surgery to benefit patients well beyond the immediate postoperative period.
References


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Volunteer studies have demonstrated a slight (17%-22%) and transient (<30 minutes) prolongation of the prothrombin time/activated partial thromboplastin time (PT/aPTT) with BRIDION; however, clinical studies have demonstrated no clinically relevant effect on peri- or postoperative bleeding complications with BRIDION alone or in combination with anticoagulants. As BRIDION has demonstrated an in vitro pharmacodynamic interaction with anticoagulants, caution should be exercised in patients on anticoagulation for a pre-existing or concomitant condition. This pharmacodynamic interaction is not clinically relevant for patients receiving routine postoperative prophylactic anticoagulation. Although formal interaction studies have not been conducted, no drug interactions were observed in clinical trials. Preclinical data suggest that clinically significant drug interactions are unlikely with the possible exceptions of toremifene, fusicid acid, and hormonal contraceptives.

\(^*\) Train-of-four
\(^1\) Post-tetanic count
\(^2\) Second twitch


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