Postoperative intestinal care after major gynecologic surgery has changed considerably. The purpose of this review was to describe changes in preoperative bowel preparation, elective postoperative nasogastric tube decompression, early postoperative feeding, and a mechanism to help reduce postoperative ileus.

Preoperative bowel preparation
For more than a century, the presence of unprepped bowel during surgery was believed to increase anastomotic leakage and infection rates. Logically, preoperative mechanical bowel preparation could reduce fecal flora and thus lower the risk of anastomotic leakage and infection. As such, this dogma has been passed down through the years on the basis of expert opinion and not scientific studies. In a review by Guenaga et al of 13 prospective randomized trials that included 4777 patients who underwent large bowel resection, anastomotic leakage occurred in 4% of the patients with a preoperative mechanical bowel preparation, compared with 3% of the patients with no preparation ($P = .15$). Wound infection occurred in 10% of the patients with preparation, compared with 8% of the patients with no preparation ($P = .09$). The authors concluded that the notion that mechanical bowel preparation is necessary before elective colorectal surgery should be reconsidered. The Canadian Society of Colon and Rectal Surgeons recommends that preoperative mechanical bowel preparation should be omitted.1

Similarly, preoperative oral antibiotic bowel preparation is associated with increased nausea, vomiting, and abdominal pain and does not decrease postoperative infections and therefore is not recommended.2 Although preoperative mechanical bowel preparation should be omitted for elective abdominal cases, there is controversy as to whether its use before advanced gynecologic laparoscopic procedures improves the visibility of the surgical field. In a prospective randomized trial of 162 patients who underwent gynecologic laparoscopic procedures, oral sodium phosphate did not improve the quality of the surgical field.4 Unfortunately, randomized data on this topic are limited.

The traditional postoperative feeding protocol
Postoperative intestinal care after major gynecologic abdominal surgery has changed considerably over the last 2 decades. The traditional postoperative feeding protocol after major abdominal surgery has included nasogastric decompression. Nasogastric tubes are removed when bowel sounds, flatus, and bowel movement are present and when nausea, vomiting, and abdominal distention are absent. If nausea and vomiting do not develop after removal of the nasogastric tube, a clear liquid diet is begun, and diet is advanced slowly to solids over several days. The rationale for the traditional postoperative feeding protocol is to prevent vomiting and ileus. It was believed that vomiting increased the incidence of aspiration pneumonia and that ileus increased the incidence of wound dehiscence and intestinal leaks. In the early days of surgery, vomiting was common after major abdominal surgery, in part because of the anesthetic agents that were used and the lack of centrally acting antiemetics (such as ondansetron). The traditional postoperative feeding protocol is still used. In a survey of the Society of Gynecologic Oncologists in 1998, the traditional postoperative feeding protocol that included nasogastric decompression was used by 67% of gynecologic oncologists after ovarian cytoreduction, by 34% after lymphadenectomy, by 29% after radical hysterectomy, and by 15% after routine abdominal hysterectomy.5 Two major trends in the late 1980s and 1990s have led to challenging the traditional postoperative feeding protocol. Originally, laparoscopy was restricted to diagnostic procedures and tubal sterilization. After laparoscopy, patients were fed immediately rather than according to the traditional postoperative feeding protocol. In the late 1980s and 1990s, major gynecologic surgical procedures were performed laparoscopically. Many physicians abandoned the traditional postoperative feeding protocol.
when these surgical procedures were performed laparoscopically rather than through a large abdominal incision. The second major impetus was health care economics that insisted on early postoperative discharge, which challenged physicians to reevaluate the traditional postoperative feeding protocol.

Postoperative ileus

Significance and incidence

A common complication of abdominal surgery is postoperative ileus (colonic stasis) that leads to patient discomfort, increased hospital stay, and increased cost. In a review of the Premier Perspective Database, which includes about one-sixth of all US hospitalizations, postoperative ileus was found to increase hospital stay by approximately 30% and to result in an increase in cost in excess of $5000-10,000 per ileus and $1.5 billion per year in the United States.6 The incidence of postoperative ileus after gynecologic surgery ranges from 5-25%; the highest rates occur after laparotomy.7,9 Thus, postoperative ileus is common, painful, and expensive.

Definition, cause, and site

Although ileus is defined as the inhibition of bowel motility, there is no standard definition of postoperative ileus. The symptoms of postoperative ileus include nausea and vomiting, abdominal distention and tenderness, and delayed passage of flatus and stool. When postoperative ileus in clinical trials is reported on, commonly used surrogate definitions include prolonged absence of flatus, persistent nausea and vomiting, the need for insertion of nasogastric tube for decompression, prolonged hospitalization, and readmission for vomiting.5,7,9 Although there is no agreement on the definition, it is usually accepted that postoperative ileus has resolved with the passage of flatus/stool and tolerance of adequate oral intake.

The exact cause of postoperative ileus is unknown, but the 3 most likely mechanisms that are involved in its development are gastrointestinal inflammatory response and neurogenic and pharmacologic mechanisms.10,11 The acute phase of postoperative ileus is believed to be primarily neurogenic that results from peritoneal irritation that causes stimulation of afferent reflexes. The prolonged phase of postoperative ileus is believed to be a stress response to tissue trauma that triggers a gastrointestinal inflammatory response. The pharmacologic mechanism mainly involves the use of perioriparative opioids. The final pathway of the neurogenic, gastrointestinal inflammatory, and pharmacologic mechanisms is believed to be activation of the gastrointestinal mu-opioid receptors, which inhibit the release of acetylcholine from the mesenteric plexus which in turn disrupts peristalsis that leads to uncoordinated nonpropulsive contractions.

Although the stomach and small intestines recover quickly after surgery (return to normal activity within 8 hours), it is the colon, specifically the rectosigmoid, which can take up to 3-5 days before the return of normal peristalsis. Woods et al12 placed electrodes in the stomach, small bowel, ascending colon, and descending colon in monkeys. Myoelectric activity of the intestine was observed at a baseline, after anesthesia, and after anesthesia and a “sham” abdominal surgery. Although anesthesia alone had little effect on intestinal motility, anesthesia with abdominal surgery caused a significant change in motility. The stomach and small intestines returned to normal activity within 8 hours. However, the right colon took 48 hours and the sigmoid colon took 72 hours to return to normal contractility in this study. Wilson13 performed a similar study in humans. The night before surgery, 39 patients swallowed radiotelemetry capsules. Abdominal x-ray films the morning of surgery localized the transmitters in the right ascending colon. After abdominal surgery, normal right colonic activity was delayed for 48 hours, independent of the actual surgical procedure that had been performed. These studies confirmed that the length of the surgical procedure and the amount of intestinal manipulation had little effect on colonic stasis with 1 exception: retroperitoneal dissection was associated significantly with colonic stasis compared with other abdominal procedures.12,13 In a report of 46 patients who underwent radical paraaortic lymphadenectomy for gynecologic cancer, 50% of them experienced postoperative ileus.14

Elimination of postoperative nasogastric decompression

In 1995, a metaanalysis combined 26 prospective randomized trials that compared postoperative nasogastric decompression with no postoperative nasogastric decompression after elective major abdominal surgery in 3964 patients.15 One of the reasons for the use of postoperative nasogastric decompression is to prevent vomiting and aspiration pneumonia. However, withholding nasogastric decompression had no effect on emesis (10% [nasogastric decompression] vs 8% [nasogastric decompression]; P = .11), and only 5% of the patients without nasogastric decompression required postoperative nasogastric tube insertion. Postoperative pneumonia was increased in the nasogastric decompression group (6% [nasogastric decompression] vs 2% [no nasogastric decompression]; P = .0001), which refutes this theory. Another reason commonly used in support of postoperative nasogastric decompression is to prevent ileus and decrease the incidence of wound dehiscence and intestinal leaks. However, nasogastric decompression did not significantly affect the incidence of postoperative dehiscence (2% [nasogastric decompression] vs 1% [no nasogastric decompression]; P = .06) and intestinal leaks (1% [nasogastric decompression] vs 1% [no nasogastric decompression]; P = .93), although the trend favored the omission of nasogastric tube use. Similar findings were noted in a recent review of 28 prospective randomized trials in 4194 patients in which patients who did not have a nasogastric tube placed routinely had earlier return of bowel function (P < .00001) and fewer pulmonary complications (P = .01) with a nonsignificant trend towards fewer wound infections (P = .22) and ventral hernias (P = .09).16

Therefore, class I data consistently demonstrate that routine nasogastric tube decompression after surgery does not accomplish any of the aforementioned goals and is associated with an increased incidence of pneumonia. Hence, elective postoperative nasogastric tube decompression is not indicated.15,16 It should be noted that patients with preoperative bowel obstruction were ex-
Early feeding after major gynecologic surgery

Recently, several prospective randomized trials reported on the safety of early postoperative feeding after major gynecologic surgery, mostly major gynecologic oncology surgery (Table 1). As opposed to the traditional postoperative feeding protocol, early or immediate feeding consists of a diet of the patient’s preference once she has recovered from anesthesia. Schilder et al\textsuperscript{17} randomly assigned 96 patients to the traditional postoperative feeding protocol vs immediate feeding and reported no increase in aspiration pneumonia, wound dehiscence, or intestinal leakage in the early feeding group. Length of hospital stay was reduced from 4-3 days (\(P = .008\)). Pearl et al\textsuperscript{18} performed a similar trial of the traditional postoperative feeding protocol vs immediate feeding on 200 patients and also reported that no increase occurred in aspiration pneumonia, wound dehiscence, or intestinal leakage and that the hospital stay was reduced from 6-5 days (\(P = .001\)) in the immediate feeding group. Steed et al\textsuperscript{19} randomly assigned 96 patients and reported no increased complications and a hospital stay that was reduced 2 days in the immediate feeding group (4 vs 6 days; \(P = .0001\)). Cutillo et al\textsuperscript{20} randomly assigned 122 patients and reported significantly faster time to toleration of diet (3 vs 5 days; \(P < .01\)), passage of first stool (3 vs 4 days; \(P < .01\)), and shorter hospital stay (5 vs 6 days; \(P < .05\)) in the immediate feeding group, with no difference in the complication rate. Similarly, Minig et al\textsuperscript{21} randomly assigned 143 patients to early feeding vs the traditional postoperative feeding protocol and not only confirmed a shorter hospital stay (5 vs 6 days; \(P = .006\)) but also reported fewer complications in the early feeding group (17% vs 39%; \(P = .003\)). Postoperative infections were lower (3% vs 14%; \(P = .02\)) and patient satisfaction scores were higher (83 vs 72 mm; \(P = .001\)) in the early feeding group. Finally, a recent review did not show any difference in complications between patients that were fed early or had delayed feeding, except for death, which was decreased significantly in the early feeding group; however, this difference may not be attributable to early feeding directly.\textsuperscript{22} Although individual complications in that review failed to reach statistical significance, the trend clearly favored early feeding that demonstrated fewer postsurgical complications in the early feeding group.

Multiple prospective randomized trials (class 1) have shown that early feeding after major abdominal gynecologic surgery does not increase and may decrease pneumonia, wound infections, and dehiscence and reduce hospital stay.

Although the incidence of emesis may have been higher in the early feeding group of several trials, it rarely represented a sign of postoperative ileus and quickly resolved in the patients who were fed early. Therefore, radiologic evaluation for these patients is not necessary, unless it persists.

### Table 1: Early feeding and gynecologic surgery

<table>
<thead>
<tr>
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<td>Fewer overall complications</td>
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</table>

### Medical benefits of early postoperative feeding

Basic science animal research has demonstrated 2 major benefits of early postoperative feeding: decreased infection and improved anastomotic healing. Animal studies have shown that early postoperative feeding prevents gastrointestinal mucosal atrophy and preserves normal gut flora, thus decreasing bacterial seeding from the gut and resulting in decreased infections.\textsuperscript{23} Other animal studies have shown that the pressure that is required to burst a gastrointestinal anastomosis is greater and collagen concentration is increased after early postoperative feeding.\textsuperscript{24} Although the exact mechanism by which early postoperative feeding improves anastomotic healing remains unknown, the increased collagen synthesis and/or decreased collagen breakdown may be the result of a direct trophic ef-
fect, a decreased gastrointestinal inflammatory response, or mechanical loading.

In a metaanalysis of 13 prospective randomized trials that included 1173 patients, early postoperative feeding after colorectal surgery resulted in a significant decreased mortality rate (decreased 59%; 95% confidence interval, 0.18–0.93). Although not statistically significant, there was a reduction in complications: wound infection decreased 23%; pneumonia decreased 24%, and anastomotic dehiscence decreased 31%.27 In a review of early postoperative feeding after gynecologic surgery, there was no statistically significant reduction in complications; however, the trend clearly favored early feeding.28

Active methods that may reduce postoperative ileus

The mechanism by which early feeding and gum chewing helps reduce postoperative ileus is believed to be the activation of the cephalic-vagal pathway that stimulates intestinal myoelectric activity that attempts to counteract the activation of the gastrointestinal mu-opioid receptors. As mentioned earlier, numerous trials of early feeding after major gynecologic and colorectal surgery have shown that early feeding decreases postoperative ileus. Similarly, in a meta-analysis of 9 prospective randomized trials that included 437 patients, gum chewing after colorectal surgery also decreased postoperative ileus by 1 day ($P = .016$) and was not associated with side-effects.28 Postoperative gum chewing also appears to demonstrate a similar positive effect.

Another, less well-studied mechanism to help reduce postoperative ileus is pharmacologic bowel stimulation, which is believed to counteract the activation of the gastrointestinal mu-opioid receptors. Five trials of postoperative bowel stimulation are presented in Table 2. In a trial of bowel stimulation with 30 mL of milk of magnesia twice daily and biscolic suppositories every day without immediate feeding after radical hysterectomy, hospital stay was reduced from 8–4 days.30 In a separate trial of bowel stimulation with 45 mL of fleet phosphor-soda every day and immediate feeding after radical hysterectomy, hospital stay was reduced further to 3 days.30 In a third nonrandomized trial of 707 patients who underwent major gynecologic surgery by the same authors, immediate feeding and bowel stimulation with 30 mL of milk of magnesia twice daily and biscolic suppositories daily decreased the rate of postoperative ileus in this patient population to 1%, which is the lowest incidence to be reported.31 Similarly, in a Danish prospective randomized study after hysterectomy, bowel stimulation with magnesium oxide decreased the time to defecation by 35% ($P = .001$).32 In a separate prospective randomized study of 200 patients after colorectal surgery, bowel stimulation with bisacodyl reduced hospital stay 1 day ($P = .007$).33 None of the 5 studies reported any significant side-effects from postoperative bowel stimulation, although individually most of the studies were too small to detect differences that may be subtle.

Alvimopan is a selective opioid antagonist with limited oral absorption that directly counteracts the activation of the gastrointestinal mu-opioid receptors. In a prospective randomized trial after major gynecologic and colorectal surgery in 79 patients, alvimopan decreased postoperative ileus by 1 day (3 vs 2 days; $P = .03$) and hospital stay by 1 day (4 vs 3 days; $P = .03$).34

Ketorolac is a nonsteroidal antiinflammatory drug that may decrease the gastrointestinal inflammatory response and can also reduce postoperative opioid usage. In a prospective randomized trial after colorectal surgery in 102 patients, ketorolac use reduced the immediate postoperative consumption of opioids and was also found to diminish the time to normal bowel function by 1 day (3 vs 4 days; $P = .01$).35

In summary, early feeding has been shown clearly to have a positive effect on postoperative bowel function. Although less well studied, gum chewing, bowel stimulation, the use of alvimopan, and the use of ketorolac appear to decrease the time to normal bowel function and diminish postoperative ileus rates. Further randomized studies are required to confirm this effect.

Treatment of postoperative ileus

Similar to preoperative mechanical bowel preparation, elective postoperative nasogastric tube decompression, and traditional postoperative feeding protocol, the treatment of postoperative ileus is based on expert opinion and not scientific studies. The traditional treatment of postoperative ileus includes nasogastric tube decompression, hydration, and electrolyte balance. Although we were

<table>
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<th>Results</th>
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<td>Hansen et al</td>
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<td>Gastrointestinal</td>
<td>1</td>
<td>Bisacodyl</td>
<td>Hospital stay decreased 1 day .007</td>
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</tr>
</tbody>
</table>

unable to locate any prospective randomized studies on nasogastric tube decompression, retrospective trials have reported successful treatment without nasogastric tube decompression. In a retrospective trial of 22 patients who experienced postoperative ileus after lymphadenectomy for gynecologic cancer, ileus resolved in all patients without nasogastric tube decompression.\textsuperscript{14}

Because the cause of postoperative ileus is believed to be the activation of the gastrointestinal mu-opioid receptors, which disrupts peristalsis, treatment of postoperative ileus with bowel stimulation appears logical. Multiple retrospective reports have shown prompt resolution of postoperative ileus after water-soluble radiopaque contrast. In a retrospective report of 40 obstetric, gynecologic, and general surgical patients with postoperative ileus, the resolution of postoperative ileus occurred at a median of 6 hours after the administration of water-soluble radiopaque contrast (gastrografin).\textsuperscript{36} However, we were unable to locate any prospective randomized trials. A review of pharmacologic treatment of postoperative ileus reviewed 39 prospective randomized trials with 4615 patients.\textsuperscript{37} Erythromycin by mouth, systemic lidocaine, and metoclopramide by mouth were ineffective. Alvimopan may prove beneficial, but further trials are needed. Gum chewing and pharmacologic bowel stimulation (milk of magnesia twice daily and biscolic suppositories) should be evaluated.

Therefore, there are sparse scientific data on the optimal treatment of postoperative ileus.

**Summary**

**Class I trials: level A recommendations**

1. Electrolyte replacement in patients with dehydration, hypovolemia, and/or hypotension.
2. Early feeding, gum chewing, and bowel stimulation, alvimopan, and ketorolac may decrease the incidence of postoperative ileus.
3. Early feeding after major abdominal gynecologic surgery does not increase and may decrease pneumonia and other postoperative complications.
4. Early postoperative feeding after bowel resection decreases postoperative infections and has a trend towards lower rates of anastomotic dehiscence.

**Class II/III trials: level B recommendations**

1. Slow advancement of diet is unnecessary.
2. Early feeding after major abdominal gynecologic surgery reduces hospital stay.

**Class III: level C recommendations**

1. Vomiting is common after immediate postoperative feeding but is rarely a sign of prolonged ileus or bowel obstruction.
2. There are sparse scientific data on the optimal treatment of postoperative ileus.

**REFERENCES**


