GYNECOLOGY

Incidence and risk factors of early postoperative small bowel obstruction in patients undergoing hysterectomy for benign indications

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BACKGROUND: Small bowel obstruction (SBO) is a major cause of postoperative mortality and morbidity following abdominal and pelvic surgery, with 225,000—345,000 annual admissions. SBO may be classified based on onset from day of surgery. Early SBO occurs within the first 30 days following surgery, whereas late SBO occurs after the initial 30-day postoperative window. The majority of either type of bowel obstruction is believed to be secondary to intra-abdominal adhesions. Early SBO warrants special attention because of the difficulty in distinguishing between mechanical and nonmechanical obstruction during this period. Whereas conservative management often leads to resolution of nonmechanical obstruction and some partial SBO, surgical management is associated with a higher rate of complications compared to surgery for late SBO because of the presence of hypervascular adhesions in the early postoperative period. The current literature regarding SBO, and early SBO in particular, following hysterectomy is limited. Given that approximately 400,000 hysterectomies are performed annually, understanding the risk factors associated with SBO following these types of surgeries is imperative for improving patient outcomes.

OBJECTIVE: The objective of this study was to evaluate the incidence of and risk factors for early small bowel obstruction (SBO) after hysterectomy for benign indications.

MATERIALS AND METHODS: This was a retrospective cohort study using data from the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) database from 2014 to 2016. Current Procedural Terminology codes were used to identify patients undergoing hysterectomy for benign indications with or without concomitant colpopexy, lysis of adhesions (LOA), adnexectomy, or appendectomy. Data on patient demographics and clinical and surgical factors were obtained. Patients were then stratified into those with and those without SBO. Pairwise comparison was performed using the Wilcoxon rank-sum test and Fisher exact tests. Multivariable logistic regression was used to identify significant independent predictors of SBO.

RESULTS: Of 47,937 hysterectomies, SBO occurred in 286 patients, at a rate of 5.9 per 1000 hysterectomies. Comparing patients with and without SBO, those with an obstruction were older (49 vs 46 years, $P < .001$) and were more likely to smoke (21.0% vs 15.8%, $P = .02$), to have a history of prior abdominal surgery (73.4% vs 65.4%, $P = .005$), and to have medical comorbidities such as hypertension and dyspnea. Patients experiencing SBO were also more likely to undergo abdominal hysterectomy (72.0% vs 21.2%, $P < .001$), adhesiolysis (5.2% vs 2.1%, $P < .001$), appendectomy (1.7% vs 0.5%, $P = .02$), and cystotomy repair (1.0% vs 0.3%, $P = .002$). After logistic regression, route of hysterectomy was not a significant risk factor for SBO, whereas wound class ≥ 3 (adjusted odds ratio [aOR], 5.96; 95% confidence interval [CI], 2.71—12.99) and perioperative transfusion (aOR, 5.01; 95% CI, 3.54—7.13) were the most significant risk factors. Additional risk factors for early SBO included nonwhite race (aOR, 1.84; 95% CI, 1.33—2.48), increasing age (aOR, 1.04; 95% CI, 1.02—1.05), prior abdominal or pelvic surgery (aOR, 1.49; 95% CI, 1.17—2.03), operating times >170 minutes (aOR, 1.90; 95% CI, 1.37—2.58), uterine weight >250 g (aOR, 1.54; 95% CI, 1.11—2.14), lysis of adhesions (aOR, 2.10; 95% CI, 1.23—3.66), and concurrent appendectomy (aOR, 2.64; 95% CI, 1.06—6.65).

CONCLUSION: Early SBO is a rare complication of benign hysterectomy. Although route of hysterectomy was not found to be a significant risk factor for early SBO, variables typically associated with abdominal hysterectomy compared to minimally invasive hysterectomy, including higher wound class, larger uteri, and perioperative transfusion (a marker of intraoperative blood loss), were strongly correlated with subsequent development of early obstruction.

Key words: Hysterectomy, small bowel obstruction, postoperative complications

Postoperative small bowel obstruction (SBO), either mechanical or functional, is a major cause of mortality and morbidity following abdominal and pelvic surgery.[1] Recent estimates suggest that approximately 225,000—345,000 patients are admitted annually for SBO, at an approximate cost of 1.3 billion dollars annually.[2,3] Most postoperative bowel obstructions occur after gastrointestinal tract surgery. Although SBO after hysterectomy is uncommon by comparison, with reported rates between 0.12% and 1.1% depending on route of surgery,[4−6] given that more than 400,000 hysterectomies are performed annually, the absolute number of patients who could experience an SBO following hysterectomy is potentially in the thousands.[7]

Bowel obstructions may be subdivided by time of onset as related to the initial surgery. Early SBO is defined as occurring within the first 30 days following surgery, whereas late SBO occurs after the first 30 days.[4] The majority of bowel obstructions are believed to be due to intra-abdominal adhesions, which can begin to form in the

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AJOG at a Glance

Why was this study conducted?
To better understand the incidence and risk factors of early small bowel obstruction following hysterectomy.

Key findings
Early postoperative SBO occurs rarely after benign hysterectomy. Most patients will develop SBO after discharge and most can be managed conservatively and without surgery. Wound class ≥3 and perioperative transfusion are the most significant risk factors for developing early SBO. Non-white race, older age, prior abdominal or pelvic surgery, operating times exceeding 170 minutes, uterine weight greater than 250 grams, lysis of adhesions, and concurrent appendectomy were also associated with increased risk of SBO.

What does this add to what is known?
This study represents the largest sample of post-hysterectomy SBO described in the literature and provides better characterization of the chronicity, management and risk factors for early SBO.

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immediate postoperative period;[8] however, early SBO warrants special consideration because it may be due to either mechanical obstruction from adhesions or paralytic ileus, and the two may be indistinguishable from one another unless a clear cause of mechanical obstruction can be identified during the evaluation.[8] This presents a challenge in management of early SBO for several reasons: (1) paralytic ileus often resolves with conservative management, usually consisting of nasogastric tube decompression and bowel rest; and (2) in cases of mechanical obstruction, surgical management is associated with significantly higher rates of serious morbidity compared to surgical management of late SBO.[4,8]

Few studies have evaluated SBO following hysterectomy, and the literature specifically focused on the incidence and management of early SBO is even sparser. Antosh et al performed a retrospective case-control study including 88 patients who experienced SBO after hysterectomy. Cystotomy, adhesiolysis, postoperative transfusion, and concomitant bowel surgery were identified as independent risk factors for SBO, the majority of which occurred in the first week after surgery.[9] Due to limitations of the study, the authors could not comment on the effect of mode of hysterectomy on the risk of SBO and were unable to describe the incidence and

management of early SBO following hysterectomy. Our objective was to determine the incidence, risk factors, and trends in management of early SBO following hysterectomy for benign indications, using a national surgical database.

Materials and Methods

This was a retrospective, nested cohort study using demographic and clinical data from the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) database between the years 2014 and 2016. The NSQIP database captures data on more than 150 perioperative variables, including preoperative comorbidities, intraoperative variables, and 30-day mortality and morbidity outcomes for multiple surgeries. Data from more than 600 participating hospitals are collected by certified Surgical Clinical Reviewers, and data quality is maintained by standardizing training of all reviewers as well as intermittent interrater reliability audits of participating sites. Data from each site are obtained from medical chart review as well as direct contact with patients.[10] NSQIP reports a 95% success rate in capturing outcomes on all cases within the database. The database uses Current Procedural Terminology (CPT) to determine all procedures. Patients <18 years of age are excluded from the database.
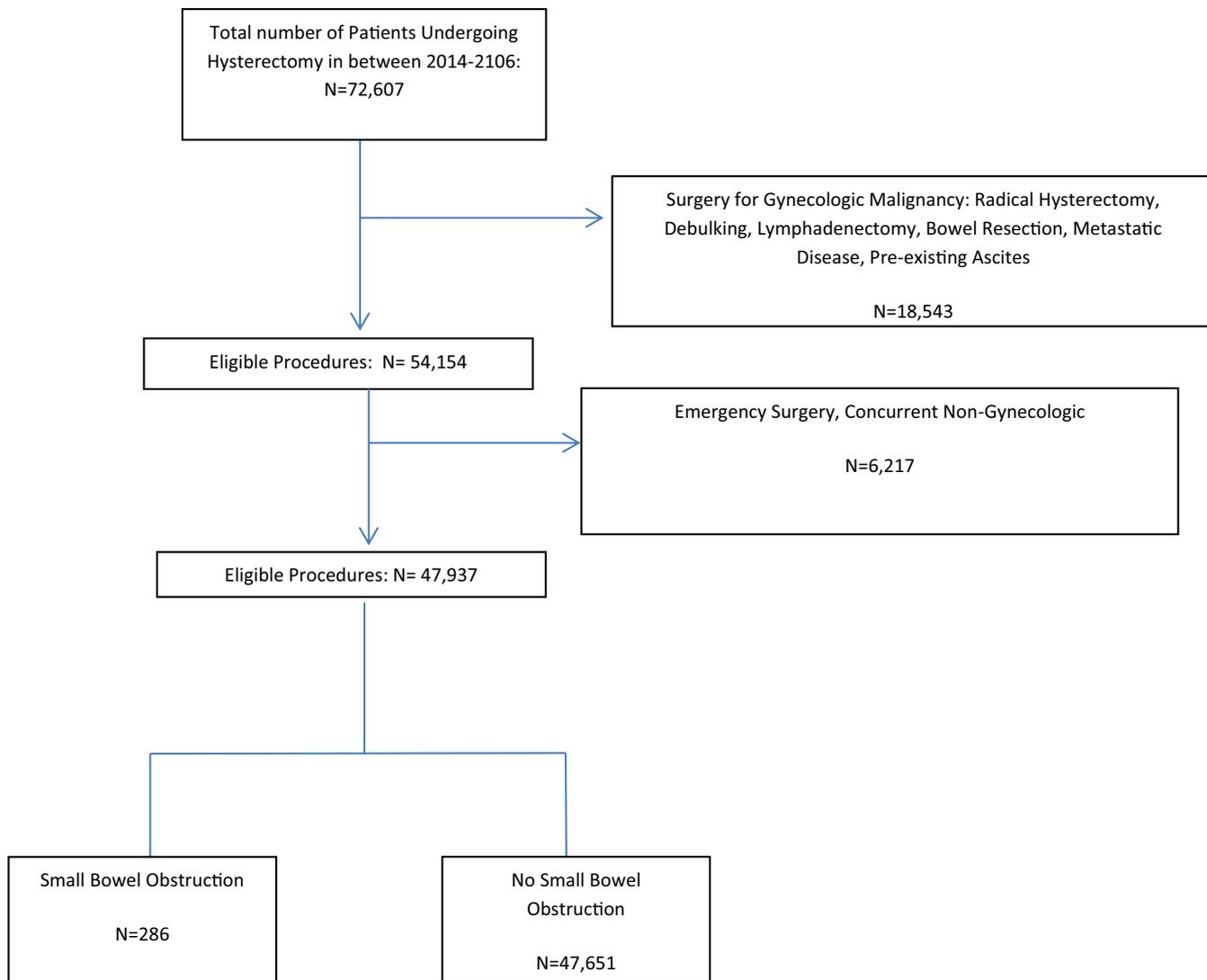
Since 2014, ACS-NSQIP has collected targeted data specific to hysterectomy. These data include parity, presence and location of endometriosis, history of abdominal and pelvic surgery, presence of pelvic inflammatory disease with or without tubo-ovarian abscess (TOA), uterine weight, as well as presence and location of neoplastic tissue. It also contains information about development of bowel obstruction, urinary tract injury, and fistula formation. This dataset may be combined with the general NSQIP data set using a unique numerical identifier assigned to each patient.

The following CPT codes were used to identify patients who underwent hysterectomy: abdominal hysterectomy (58150, 58152, and 58180), laparoscopic hysterectomy (58541–58544, 58550–58554, and 58570–58573), and vaginal hysterectomy (58260, 58262, 58263, 58267, 58270, and 58290–58294). Because of the small number of laparoscopic-assisted vaginal hysterectomy and laparoscopic supracervical hysterectomy, and the fact that NSQIP does not currently include a descriptor for robotic-assisted laparoscopic procedures, all hysterectomies using laparoscopy were combined into a single variable.

Exclusion criteria included patients who underwent bowel resection, lymphadenectomy, radical hysterectomy, tumor debulking, had a pre- or postoperative diagnostic code for malignancy, had abdominal or pelvic tumors, or underwent a lymphadenectomy. In addition, patients undergoing concurrent nongynecologic surgery, and those with incomplete records were excluded from analysis. NSQIP also automatically excludes patients <18 years of age from the database.

Clinical factors that were included in the analysis were as follows: age, race, body mass index (BMI), parity, length of stay, history of prior abdominal or pelvic surgery, smoking status within 1 year of surgery, diabetes mellitus, hypertension requiring medication, dyspnea, functional status, history of congestive heart failure or prior cardiac intervention, chronic obstructive pulmonary disease,

FIGURE 1
Patient inclusion and exclusion criteria

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┌─────────────────────────────────┐
│  Total number of Patients Undergoing  │
│  Hysterectomy in between 2014-2106:   │
│            N=72,607                   │
└─────────────────────────────────┘
          │
          │       ┌───────────────────────────────────────────────┐
          │──────▶│  Surgery for Gynecologic Malignancy: Radical   │
          │       │  Hysterectomy, Debulking, Lymphadenectomy,     │
          │       │  Bowel Resection, Metastatic Disease,          │
          │       │  Pre-existing Ascites                          │
          │       │                 N=18,543                       │
          ▼       └───────────────────────────────────────────────┘
┌─────────────────────────────────┐
│  Eligible Procedures: N= 54,154 │
└─────────────────────────────────┘
          │
          │       ┌───────────────────────────────────────────────┐
          │──────▶│  Emergency Surgery, Concurrent Non-Gynecologic │
          │       │                 N=6,217                        │
          ▼       └───────────────────────────────────────────────┘
┌─────────────────────────────────┐
│  Eligible Procedures: N= 47,937 │
└─────────────────────────────────┘
          │
    ┌─────┴─────┐
    ▼           ▼
┌─────────┐  ┌──────────────┐
│ Small   │  │ No Small     │
│ Bowel   │  │ Bowel        │
│Obstruct.│  │ Obstruction  │
│ N=286   │  │  N=47,651    │
└─────────┘  └──────────────┘
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coagulopathy, systemic steroid use, preoperative transfusion, American Society of Anesthesiology class, uterine weight, presence of endometriosis and pelvic inflammatory disease, concomitant lysis of adhesions, colpopexy, cystotomy repair, appendectomy, wound class, mode of hysterectomy, and operating time. Wound class was defined using the National Healthcare Safety Network classifications.[11]

All pre-existing clinical conditions were defined as being present within 1–6 months prior to surgery. Functional status was defined as totally dependent, partially dependent, and independent. Because of the very small number of patients who were listed as either partially or totally dependent, these were combined into a single variable.

Patients were then stratified into 2 groups: those with and those without an SBO. Small bowel obstruction was defined in NSQIP as patients requiring decompression with surgery or a nasogastric tube or who were nil per os (NPO) for 3 or more days after hysterectomy.[10] Descriptive statistics are reported as means with standard deviations. Pairwise comparison was performed using the Wilcoxon rank-sum test or Fisher exact test where appropriate. Stepwise backward multivariable logistic regression was used to identify factors associated with postoperative bowel obstruction. For the logistic regression model, only variables with a P value of ≤ 0.2 based on univariable analysis were included. Collinearity testing was performed on the variables in the final regression model; none had a variance inflation factor of >10, indicating that they were independent of one another. All statistical analysis was performed using Stata

TABLE 1
Clinical characteristics of patients with and without small bowel obstruction

Characteristic	SBO (n = 286)	No SBO (n = 47,651)	P value
Race, nonwhite	147 (51.3)	16,185 (34.0)	<.001
Age, y, median (IQR)	49 (42—49)	46 (41—53)	<.001
BMI, kg/m^2, median (IQR)	29.0 (24.3—35.2)	29.5 (25.3—35.0)	.18
Parity, median (IQR)	2 (1—3)	2 (1—3)	.30
History of abdomino-pelvic surgery	210 (73.4)	31,181 (65.4)	.005
Current smoker	60 (21.0)	7546 (15.8)	.02
Diabetes mellitus	29 (10.1)	3679 (7.7)	.12
Hypertension requiring medication	106 (37.1)	13,020 (27.3)	<.001
Dyspnea	21 (7.3)	1217 (2.6)	<.001
Chronic obstructive pulmonary disease	6 (2.1)	449 (0.9)	.16
Coagulopathy	3 (1.0)	332 (0.7)	.99
Chronic steroid use	8 (2.8)	708 (1.5)	.07
Preoperative transfusion	6 (2.1)	346 (7.3)	.007
Functional status (partially/totally dependent)	2 (0.7)	110 (0.2)	.10
ASA class ≥3	93 (32.5)	10,457 (21.9)	<.001
Length of stay	3 (2—7)	1 (1—2)	<.001

ASA, American Society of Anesthesiology; *IQR*, interquartile range; *SBO*, small bowel obstruction.

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version 14.1 (StataCorp, College Station, TX).

Studies using the NSQIP database are considered exempt by our institutional review board.

Results

Of 72,607 total hysterectomies during the study period, 47,937 met all inclusion criteria. Of these, there were 286 early SBOs occurring at a rate of 5.9 per 1000 hysterectomies (Figure 1). Of these, 125 patients (43.7%) developed SBO during the initial hospital stay and 66 (23.1%) underwent reoperation. The median number of days from the time of surgery until SBO diagnosis was 5 (interquartile range [IQR], 3—9). Tables 1 and 2 list the preoperative and perioperative characteristics of both groups. Patients who developed a bowel obstruction postoperatively were more likely to be nonwhite (51.3% vs 34.0%, P < .001), to have a prior history of abdominal or pelvic surgery (73.4% vs

65.4%, P = .005), to smoke (21.0% vs 15.8%, P = .02), and to have preoperative comorbidities, such as hypertension and dyspnea. Although the difference in median age was statistically significant (49 years in the SBO group vs 46 years in the non-SBO group, P < .001), the magnitude of the difference was small.

Operative time was 30 minutes greater in the SBO group (P < .001), and these patients had higher rates of contaminated or infected wounds (P < .001). Uterine weight was greater in the SBO group (160.5 g vs 141.8 g, P = .03). Patients with SBO were almost twice as likely to undergo surgery by a gynecologic oncologist (33.6% vs 17.4%, P < .001) and less likely to undergo surgery by an obstetrician-gynecologist (59.8% vs 74.0%, P < .001). The groups also differed by mode of hysterectomy. Abdominal hysterectomy was significantly more common in patients who developed SBO (72.0% vs 21.2%, P < .001). The rate of obstruction was 2.0%

after abdominal hysterectomy and 0.24% after both laparoscopic and vaginal hysterectomy (P = .002).

Table 3 shows the rates of postoperative complications between patients with and without SBO. With the exception of deep space surgical site infection, which did not differ between groups, patients with SBO had higher rates of all postoperative complications tracked in NSQIP. Furthermore, the majority of complications occurred after patients were diagnosed with a bowel obstruction. Only organ space infection, sepsis, and pulmonary embolism occurred in greater frequency prior to the diagnosis of SBO. There were a total of 8 deaths, with only 1 death occurring in the SBO cohort.

Of the 286 patients who developed early SBO, 66 (23.0%) underwent a second surgery during the 30-day postoperative period (Table 4). Of these patients who underwent a second surgery, 58 (87.8%) underwent reoperation for

TABLE 2
Surgical characteristics of patients with and without small bowel obstruction

Intraoperative factors	SBO (n = 286)	No SBO (n = 47,651)	P value
Uterine weight, g, median (IQR)	160.5 (86–450)	141.8 (87–274)	.03
Operating time, min, median (IQR)	159.5 (114–237)	128 (94–176)	<.001
Pelvic inflammatory disease with or without tubo-ovarian abscess	7 (2.5)	741 (1.6)	.22
Endometriosis identified at time of surgery	42 (14.7)	6084 (12.8)	.32
Wound class ≥3	13 (4.5)	501 (1.1)	<.001
Surgeon specialty			
Obstetrician-gynecologist	171 (59.8)	35,279 (74.0)	<.001
Gynecologic oncologist	96 (33.6)	8292 (17.4)	<.001
Urogynecologist	18 (6.3)	3780 (7.9)	.15
Reproductive endocrinologist	1 (0.3)	335 (0.7)	.31
Mode of hysterectomy			
Abdominal hysterectomy	206 (72.0)	10,083 (21.2)	<.001
Laparoscopic hysterectomy	62 (21.6)	25,520 (53.6)	<.001
Vaginal hysterectomy	18 (6.3)	7325 (15.4)	.006
Additional procedures			
Colpopexy	34 (11.9)	7414 (15.5)	.15
Lysis of adhesions	15 (5.2)	1008 (2.1)	<.002
Appendectomy	5 (1.7)	231 (0.5)	.002
Repair of cystotomy	3 (1.0)	144 (0.3)	.02
Perioperative transfusion	42 (14.7)	1479 (3.1)	<.001

IQR, interquartile range; *SBO*, small bowel obstruction.

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management of SBO, whereas the remainder underwent a procedure for a non−SBO-related complication and subsequently developed an obstruction following this second surgery. The median time from the index surgery to reoperation for SBO was 9 days (IQR, 5−15).

Table 5 shows the indications for nonsurgical readmission stratified by whether it occurred before or after a diagnosis of bowel obstruction. Of the total number of patients with SBO, there were 123 (43.0%) readmissions, with the majority (111, 90.2%) being for the management of SBO. Intestinal obstruction was the primary admitting diagnosis in the majority of these patients, and the median number of days to development of SBO in discharged patients was 13 (IQR, 10−23) days. Twelve patients were readmitted prior to a diagnosis of SBO, with the most common admitting diagnosis being nausea and vomiting; these patients were given a diagnosis of SBO approximately 2 days after readmission.

Table 6 shows the final multivariable logistic model. The most significant variables associated with an increased risk of early SBO were contaminated or infected wounds (aOR, 5.93; 95% CI, 2.71−12.96) and perioperative transfusion (aOR, 5.21; 95% CI, 3.66−7.29). Additional risk factors for early SBO included nonwhite race (aOR, 1.83; 95% CI, 1.34−2.48), older age (aOR, 1.03; 95% CI, 1.02−1.05), prior abdominal or pelvic surgery (aOR, 1.45; 95% CI, 1.26−2.60), operating times exceeding 170 minutes (aOR, 1.90; 95% CI, 1.39−2.59), uterine weight >250 g (aOR, 1.54; 95% CI, 1.11−2.14), lysis of adhesions (aOR, 2.12; 95% CI, 1.24−3.66), and concurrent appendectomy (aOR, 2.98; 95% CI, 1.20−7.41).

Comment
Early postoperative SBO represents a unique entity in context of hysterectomy for benign indications that has been studied to only a limited extent. The current study represents the largest reported cohort of early SBO following benign hysterectomy to date. Our results indicate that early SBO is a rare occurrence in patients undergoing hysterectomy for benign indications. Although route of hysterectomy was not found to be a significant risk factor for early SBO, variables that are typically more often associated with abdominal hysterectomy

TABLE 3
Complication rates in patients with and without small bowel obstruction

Associated complications	SBO n = 286	No SBO n = 47,651	P value
Superficial surgical site infection	11 (3.8)	587 (1.2)	<0.001
Deep surgical site infection	1 (0.4)	136 (0.3)	0.83
Organ surgical site infection	30 (10.5)	456 (1.0)	<0.001
Dehiscence	5 (1.7)	94 (0.2)	<0.001
Pneumonia	10 (3.5)	64 (0.1)	<0.001
Urinary tract infection	14 (4.9)	1176 (2.5)	0.008
Sepsis	15 (5.2)	186 (0.4)	<0.001
Deep vein thrombosis	2 (0.7)	46 (0.1)	0.001
Pulmonary embolism	11 (3.8)	124 (0.3)	<0.001
Reintubation	4 (1.5)	39 (0.1)	<0.001
Acute kidney injury	3 (1.1)	20 (0.04)	<0.001
Cardiac	2 (0.7)	37 (0.1)	0.001
Death	1 (0.4)	7 (0.01)	<0.001

SBO, small bowel obstruction.

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compared to minimally invasive hysterectomy, higher wound class, larger uteri, and perioperative transfusion were strongly correlated with subsequent development of early obstruction.

Previous authors have suggested that minimally invasive approaches to surgery are associated with less peritoneal injury and are thus less likely to lead to intra-abdominal and pelvic adhesions, the most common cause of postoperative SBO.[12-16] In this study, 2.0% of patients undergoing abdominal hysterectomy experienced SBO

TABLE 4
Indications for and days for reoperation, stratified by whether reoperation occurred before or after diagnosis of small bowel obstruction

	Reoperation after SBO diagnosis n = 58	Reoperation before SBO diagnosis n = 8
Intestinal obstruction	21 (36.2)	0 (0.0)
Bladder injury	1 (1.7)	1 (12.5)
Urinary retention	1 (1.7)	0 (0.0)
Hernia	2 (3.4)	0 (0.0)
Wound complication	1 (1.7)	5 (62.5)
Not otherwise specified	31 (53.4)	0 (0.0)
Bowel injury	0 (0.0)	2 (25.0)
Time until SBO, median (IQR)	6 (4–11)	12 (5–14)
Time to reoperation (days), median (IQR)	9 (5–15)	5 (2–11)

IQR, interquartile range; *SBO*, small bowel obstruction.

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compared to 0.24% for both laparoscopic and vaginal approaches. However, after adjusting for confounders using multivariable logistic regression, abdominal hysterectomy was no longer a statistically significant risk factor.

However, in evaluating the results carefully, our findings are actually consistent with existing findings. Although the abdominal approach to hysterectomy in and of itself was not associated with an increased risk of early SBO, variables known to be strongly associated with laparotomy, namely, wound class ≥ 3, perioperative transfusion, and higher uterine weight, were strongly associated with SBO.[17,18] Indeed, these risk factors occurred more frequently with abdominal hysterectomy compared to the minimally invasive approaches within our cohort. This points to the fact that it is the complications that arise directly from the surgical approach, rather than the approach itself, that is primarily responsible for subsequent development of SBO.

Our results are further supported by studies of SBO following non-gynecologic surgery; as in these studies, we found that perioperative complications such as contaminated and infected wounds and perioperative transfusion, indicating increased intraoperative blood loss, and which tend to occur more frequently following laparotomy compared to minimally invasive techniques, are strongly associated with SBO.[6,12,19-21] In addition, the primary risk factors for SBO identified in our study, namely, cystotomy, adhesiolysis, and blood transfusion, were identified in other studies evaluating SBO after hysterectomy.[9]

Patients who experienced SBO were found to have higher complication rates with infectious morbidity, such as surgical site infection and sepsis, occurring more often before a diagnosis of SBO. Because of the limitations of the NSQIP database, direct correlations between surgical site infectious morbidity and early SBO cannot be made; however, surgical site infection has been shown to increase the risk of SBO in other studies.[22]

TABLE 5
Indications for and days for nonoperative readmission, stratified by whether readmission occurred before or after a diagnosis of small bowel obstruction

	Readmission after SBO diagnosis n = 111	Readmission before SBO diagnosis n = 12
Time to readmission, median (IQR)	13 (10—23)	6 (4—9)
Time until SBO (days), median (IQR)	13 (10—23)	8 (6—11)
Wound infection	7 (6.3)	1 (8.3)
Pneumonia	5 (4.5)	0 (0.0)
Pulmonary embolism	1 (0.9)	0 (0.0)
Urinary tract infection	2 (1.8)	0 (0.0)
Intestinal obstruction	93 (83.8)	0 (0.0)
Intraabdominal abscess	1 (0.9)	0 (0.0)
Pain	1 (0.9)	2 (16.7)
Nausea and vomiting	0 (0.0)	9 (75.0)

IQR, interquartile range; *SBO*, small bowel obstruction.

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Only a minority of patients (23.0%) underwent reoperation during the first 30 days following surgery. However, because NSQIP does not include data beyond 30 days, it is not possible to know whether any of the other patients with SBO underwent surgery, particularly those who were readmitted later

TABLE 6
Final logistic regression model of risk factors for early postoperative small bowel obstruction

	Unadjusted OR (95% CI)	aOR (95% CI)
Race, nonwhite	2.04 (1.62—2.58)	1.84 (1.33—2.48)
Age, per year	1.03 (1.02—1.04)	1.04 (1.02—1.05)
Body mass index, per kg/m^2	0.99 (0.97—1.01)	—
Parity	0.98 (0.92—1.06)	—
History of abdomino-pelvic surgery	1.46 (1.12—1.89)	1.49 (1.17—2.03)
Current smoker	1.41 (1.06—1.88)	1.87 (1.30—2.69)
Diabetes mellitus	1.35 (0.92—1.99)	—
Hypertension requiring medication	1.57 (1.23—1.99)	—
Dyspnea	3.02 (1.93—4.74)	—
Chronic obstructive pulmonary disease	2.25 (0.99—5.08)	—
Coagulopathy	1.51 (0.48—4.74)	—
Chronic steroid use	1.91 (0.94—3.89)	—
Preoperative transfusion	2.94 (1.30—6.64)	—
Specialty, obstetrician-gynecologist[a]	—	—
Specialty, gynecologic oncologist	2.42 (1.91—3.11)	—

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in the postoperative period. This finding suggests that a large percentage of early post-hysterectomy SBO resolves with conservative management, although we cannot confirm this speculation because of limitations of NSQIP. Most patients undergoing surgery for bowel obstruction after hysterectomy did so within a median of 3 days from the time of diagnosis; therefore, it may be reasonably inferred that after patients were readmitted with SBO, conservative management was attempted prior to proceeding to the operating room, which is consistent with the current treatment paradigms for early obstruction.[23]

A major strength of this study is that it uses a well-described and validated surgical database that adheres to rigorous data collection standards. Also, to our knowledge this is the largest cohort of post-hysterectomy early SBO patients currently reported in the literature. In addition, NSQIP uses data from hospitals across the United States, and therefore, the results of this study may be generalizable to all patients undergoing hysterectomy.[24]

The major limitations of this study are related to its retrospective design and the reliance on the use of CPT codes and chart review, which are associated with documentation errors. In addition, because data collection is limited to 30 days after hysterectomy, we were unable to determine whether patients developed late SBO, occurring more than 30 days from hysterectomy. In addition, using the NSQIP definition for SBO, we cannot reliably distinguish mechanical obstruction due to adhesive disease vs paralytic ileus; therefore, the data regarding management of SBO in this study must be interpreted cautiously.

In conclusion, the results of this study suggest that early SBO is a rare complication following hysterectomy for benign indications. After adjusting for confounders, mode of hysterectomy is not associated with an increased risk of early postoperative SBO, whereas concomitant appendectomy, contaminated wounds, and postoperative

TABLE 6
Final logistic regression model of risk factors for early postoperative small bowel obstruction (continued)

	Unadjusted OR (95% CI)	aOR (95% CI)
Specialty, urogynecologist	0.78 (0.48–1.26)	—
Specialty, reproductive endocrinologist	0.49 (0.07–3.55)	—
Functional status (partially/totally dependent)	3.04 (0.75–12.38)	—
American Society of Anesthesiology class ≥3	1.61 (1.25–2.08)	—
Uterine weight ≥250 g	1.61 (1.26–2.04)	1.54 (1.11–2.14)
Operating time >170 min	2.38 (1.88–3.01)	1.90 (1.37–2.58)
Pelvic inflammatory disease with or without tubo-ovarian abscess	7.00 (0.37–22.36)	—
Endometriosis identified at time of surgery	1.18 (0.85–1.63)	—
Wound class ≥3	4.99 (2.63–9.47)	5.96 (2.71–12.99)
Abdominal hysterectomy[a]	—	—
Laparoscopic hysterectomy	0.40 (0.25–0.63)	—
Vaginal hysterectomy	0.38 (0.19–0.78)	—
Pelvic floor reconstructive procedures	1.15 (0.37–6.11)	—
Lysis of adhesions	2.56 (1.52–4.32)	2.10 (1.23–3.66)
Appendectomy	3.65 (1.49–8.92)	2.64 (1.06–6.65)
Repair of cystotomy	3.49 (1.11–11.03)	—
Perioperative transfusion	5.38 (3.85–7.49)	5.01 (3.54–7.13)

aOR, adjusted odds ratio; *CI,* confidence interval; *OR,* odds ratio.

[a] Referent.

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transfusion are most strongly associated with this postoperative complication. ∎

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