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Surgical Site Infection after Hysterectomy

Catherine W. Chan and Michael L. Nimaroff

Abstract

Surgical site infections (SSIs) are associated with increased morbidity, mortality, and healthcare costs. SSIs are defined as an infection that occurs after surgery in the part of the body where the surgery took place. Approximately 1–4% of hysterectomies are complicated by SSIs, with higher rates reported for abdominal hysterectomy. Over the past decade, there has been an increasing number of minimally invasive hysterectomies, in conjunction with a decrease in abdominal hysterectomies. The reasons behind this trend are multifactorial but are mainly rooted in the well-documented advantages of minimally invasive surgery. Multiple studies have demonstrated a marked decrease in morbidity and mortality with minimally invasive surgeries. Specifically, evidence supports lower rates of SSIs after laparoscopic hysterectomy when compared to abdominal hysterectomy. In fact, the American College of Obstetricians and Gynecologist recommends minimally invasive approaches to hysterectomy whenever feasible. This chapter will review the current literature on surgical site infection (SSI) after hysterectomy for benign indications.

Keywords: infection, hysterectomy

1. Introduction

Hysterectomy is one of the most commonly performed surgeries in the United States. In fact, Merrill et al. reported a 45% lifetime risk of hysterectomy [1] with an overall rate of 5.4 per 1000 women per year. The majority of hysterectomies are performed for benign gynecologic conditions—that is, the presence of fibroids. Other indications include abnormal uterine bleeding, uterovaginal prolapse, and pelvic pain. Hysterectomy can be performed via multiple routes—abdominally, laparoscopically (including robotic approach), or vaginally. Vaginal and laparoscopic procedures are considered minimally invasive surgical approaches based on the ability to avoid a large abdominal incision. These routes of hysterectomy are associated with shortened hospitalization and postoperative recovery when compared to the abdominal approach. As a result, analysis of U.S. surgical data demonstrates evolving practice patterns with an increase in minimally invasive hysterectomies and a decrease in abdominal hysterectomies [2, 3].

The Centers for Disease Control and Prevention defines surgical site infection (SSI) as an infection that occurs after surgery near the surgical site within 30 days following surgery or 90 days where an implant is involved. They can range from superficial infections involving skin, or more serious infections involving tissues underneath the skin, organs, or implanted materials. As such, SSI is classified as superficial, deep, or organ/space. The CDC monitors SSI via the National Healthcare

Safety Network with reported SSI rates of 1.7% and 0.9% after abdominal and vaginal hysterectomy respectively [4].

In a retrospective cohort study of 23,366 patients undergoing laparoscopic and abdominal hysterectomy between the years 2005 and 2011, 783 (3%) developed a surgical site infection. The majority of these were wound infections with approximately 1/4 of cases being infections of the organ space which represents 0.7% of the entire cohort [5]. A more recent large cohort study examining patients between the years 2012 and 2015 demonstrated a 2% incidence of postoperative infection after hysterectomy [6]. When stratified between abdominal versus minimally invasive approaches, the incidence of SSI in the abdominal hysterectomy group exceeded 1%, while the incidences in the other groups were 0.2–0.3% [7–9].

It is well known that postoperative infections are associated with increased patient morbidity and mortality, and may result in additional costs, extended hospital stays, and prolonged antibiotic use. On average, patients who had an SSI following hysterectomy incur twice the cost of care of their counterparts who did not have an SSI. In a study examining the clinical and economic burden of surgical site infection following hysterectomy, the highest cost owing to SSI (\$19,203; 95% CI 17,260–21,365) was for abdominal hysterectomy. In addition, those who had SSI had a mean length of stay (LOS) that was between three and fivefold the LOS of those who did not have an SSI irrespective of surgical approach [10]. SSI following index surgery is also associated with a significantly greater percentage of hospital readmissions. Surgical site infections after hysterectomy have serious implications on patient care and healthcare as a whole. This chapter will review the current literature on surgical site infection (SSI) after hysterectomy for benign indications and address various methods of prevention and treatment.

2. Route of hysterectomy

There are a variety of factors that influence the route of hysterectomy including informed patient preference, accessibility of the uterus, extent of extrauterine disease, size and shape of the vagina and uterus, concurrent procedures, available hospital technology and support, the nature of the case—whether it is emergent or scheduled, and surgeon training and experience. The American College of Obstetricians and Gynecologists (ACOG) recommends vaginal hysterectomy as the approach of choice whenever feasible [11].

Evidence supports that the vaginal approach is associated with better outcomes when compared with other approaches to hysterectomy. A Cochrane review analyzing 47 randomized control trials with a total of 5,102 women determined that vaginal hysterectomy resulted in quicker return to normal activity when compared to abdominal hysterectomy. There was no difference in satisfaction, quality of life, and surgical complications. Similarly, laparoscopic hysterectomy also resulted in more rapid recovery, fewer febrile episodes, and lower incidence of SSI when compared to the abdominal approach [12]. In this systematic review, there were no advantages of laparoscopic over vaginal hysterectomy. In addition, the laparoscopic approach was associated with longer operating times and increased rates of urinary tract injuries [13]. As a result, a vaginal approach continues to be the preferred route of hysterectomy.

When it is not feasible to perform a vaginal hysterectomy, a surgeon must choose between a laparoscopic or an open abdominal approach. A Cochrane review demonstrated faster return to normal activity, shorter hospital stay, fewer infections, and improved quality of life in patients undergoing laparoscopic versus abdominal hysterectomy. However, operating times were longer with higher rates of lower urinary tract (bladder and ureter) injuries in the laparoscopy group [13].

When stratified by the type of hysterectomy—total laparoscopic hysterectomy (TLH), laparoscopic-assisted vaginal hysterectomy (LAVH), and laparoscopic supracervical hysterectomy (LSCH)—a comparison of the 30-day incidence of deep or organ-space and superficial incisional SSIs in 46,755 women demonstrated a decreased risk of deep or organ-space SSI in the LSCH group compared to the other subtypes [14]. The overall rate of 30-day deep or organ-space SSI was 1.8%. There were no differences in superficial SSI in all groups; however, the rate of deep or organ-space SSI was lower in women who underwent LSCH (0.6%) compared with TLH (1.0%) and LAVH (1.1%).

When stratified into various forms of laparoscopic hysterectomy including robotic hysterectomy, laparoscopic-assisted vaginal hysterectomy, and single-port hysterectomy, the authors concluded that more research was needed to determine if there is in fact, a benefit over conventional laparoscopic approaches. The largest study available on single port laparoscopy in gynecology was a retrospective study from Cleveland Clinic reviewing a total of 908 cases. The authors concluded that single port access was safe and feasible in gynecologic surgery inclusive of both malignant and premalignant conditions with a low rate of adverse outcomes. Perhaps the most prevalent adverse outcome is an increased risk of incisional hernia with a rate of 5.5% [15, 16]. Well-designed studies that compare outcomes of alternative hysterectomy routes (robotic, laparoscopic assisted vaginal, and single-port) are needed to determine if patients may benefit from these other approaches.

Although minimally invasive routes to hysterectomy remain the preferred approach, open abdominal hysterectomy is still an important surgical option for some patients. Open abdominal hysterectomy may become necessary in a variety of clinical scenarios including failure of to maintain a minimally invasive approach.

3. Prevention of SSI

3.1 Preoperative risk factors

Preoperative medical optimization is critically important in risk reduction for SSI prior to hysterectomy. Eliminating particular risk factors for SSI contributes vastly to perioperative care. This includes taking an in-depth medical history, performing a comprehensive physical exam, and addressing the patient's medical comorbidities. Patients should be counseled on modifiable and nonmodifiable risk factors such as smoking status, diabetes stabilization, anatomic anomalies, renal comorbidities, hydrosalpinx, endometrioma, prior laparotomy, and untreated pelvic inflammatory disease (PID) or bacterial vaginosis [17–20]. Optimal diabetes control is critical in preventing postoperative SSI with both spot glucose levels ≤ 200 mg/dl and hemoglobin A1C levels below 8.5–9.0% [21, 22].

Preoperative screening for genital tract infections is generally not necessary; however, certain types of infections are clinically important prior to hysterectomy. It has been well established that bacterial vaginosis (BV) is associated with an increased risk of postoperative cuff cellulitis and subsequent pelvic abscess formation after hysterectomy [23]. Treatment of BV prior to scheduled hysterectomy will decrease this risk.

3.2 Intraoperative interventions

Practicing safe, high-quality, evidence-based operating room care begins first with accurate identification of the patient, surgical site, and procedure.

In an AAGL white paper, “Enhanced Recovery and Surgical Optimization Protocol for Minimally Invasive Gynecologic Surgery”, infection prophylaxis can be achieved via the implementation of SSI prevention bundles [24]. Quality or safety bundles provide a framework for the implementation of evidence-based practices. They have been validated across multiple disciplines to actually decrease SSI [25–28]. The ACOG Council on Patient Safety in Women’s Health Care has published a consensus bundle on prevention of SSI prior to gynecologic surgery. This provides a framework for hospitals to develop, implement, and practice evidence-based prevention of SSIs [29].

An example of a hysterectomy bundle is as follows:

Abdominal Hysterectomy
Process Checklists
(Quality Improvement Data Sheet: Not for Medical Record)

Facility Name:		Date:	Scheduled Elective ☐	Add-on ☐	Emergent ☐	
Procedure Performed:						
Surgeon:		Admission Location: Inpatient ☐ Same Day Admission ☐				
Unit	Responsibility	Action Taken	Action Documented			
Same Day Admission (SDA)	Pre-Procedure RN	Pre-operative body wash with 2% or 4% chlorhexidine gluconate (CHG): 1. Was the body wash done 2 days prior to surgery? 2. Was the body wash done 1 day (night before or morning of surgery) prior to surgery? 3. Was separate sponge used for each body wash? 4. Did patient use fresh linen and fresh towels after body wash? 5. Did patient wear fresh clothing after the body wash? 6. Were CHG wipes used in pre-operative are prior to surgery?	Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐			
	Completed by:	(Print Name)				
	SDA RN or Pre-Procedure RN	Temperature - Goal Range 36° - 38°C: 1. Temperature ≥ 36° C on arrival to SDA? 2. Warming device applied? Identify type: ☐ Bair Paws ☐ Bair Hugger ☐ Other If temperature is ≥ 36°C, no further temperatures are needed. If ≤ 36°C retake the temperature at 1 hour. 1. Temperature at 1 hour ≥ 36°C? 2. Surgery is on hold until temperature ≥ 36°C (Elective Only)? Blood glucose (Targeted goal < 200): 1. What is the patient's blood glucose (BS) result in SDA? 2. If > 200 mg/dL was Anesthesia and the Surgeon notified? 3. Surgery on hold until treated and ≤ 200 (Elective Only)? An HgA1C value was on the patient's chart from Pre-Surgical Testing or Surgeon's office? Body Mass Index (BMI): 1. BMI >40? If yes, a wound vacuum dressing/drainage system was considered and available?	Temperature: _____ Yes ☐ No ☐ Yes ☐ No ☐ Temperature: _____ Yes ☐ No ☐ N/A ☐ Yes ☐ No ☐ N/A ☐ BS: _____ Yes ☐ No ☐ N/A ☐ Yes ☐ No ☐ N/A ☐ Yes ☐ No ☐ Yes ☐ No ☐ BMI: _____ Yes ☐ No ☐ N/A ☐			
	Completed by:	(Print Name)				
	Operating Room (OR)	Circulating RN	Temperature upon arrival to the operating room? Was the patient's abdomen prepped with CHG containing preparation when applicable? What was used for the vaginal preparation? ☐ Providone iodine ☐ IriSept ☐ 4% CHG	Temperature: _____ Yes ☐ No ☐ NA ☐ Yes ☐ No ☐ NA ☐		
Completed by:		(Print Name)				
Anesthesiologist		Was initial antibiotic prophylaxis selection and dosing given? Core temperature was checked every 30 minutes and maintained ≥36°C? If temperature < 36°C action is taken? What warming method(s) were used: ☐ Forced Air ☐ Fluid Warmer ☐ Other: Glucose level was maintained < 200 mg/dL? When applicable was re-dosing of antibiotics given within the appropriate time? Did the patient receive hyper oxygenation: FIO2 > 80% in absence of contraindications? Was there an infection Present At the Time Of Surgery (PATOS) Assigned ASA: 1 2 3 4 5 The appropriate ASA Score was assigned?	Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐ NA ☐ Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐ NA ☐ Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐			
Completed by:		(Print Name)				
Circulating RN		Time Out: The wound was classified as: ☐ Clean (I) ☐ Clean/Contaminated (II) ☐ Contaminated (III) ☐ Dirty (IV) Was a wound protector used? Was a sterile tray used at the time of closure? If wound class III or IV, were gowns and gloves changed before closing?	Yes ☐ No ☐ Yes ☐ No ☐ NA ☐ Yes ☐ No ☐			
Completed by:		(Print Name)				
Post Anesthesia Care Unit		PACU RN or Post-Procedure RN	1. What was the patient's temperature on arrival to the PACU? (Goal 36°C - 38°C) 2. If temperature < 36°C, indicate action taken: ☐ Bair Hugger ☐ Other Patient's blood glucose maintained? (Goal < 200 mg/dL for applicable patients)	Yes ☐ No ☐ Yes ☐ No ☐ NA ☐ Yes ☐ No ☐		
		Completed by:	(Print Name)			

3.3 Antibiotic prophylaxis

The degree of contamination at the time of surgery is classified using the National Healthcare Safety Network (NHSN) wound class. Hysterectomy is a clean-contaminated procedure and as a result, is unavoidably associated with a relatively higher risk of infection as the procedure breaches the genital tract. Common sites of infection after hysterectomy include the abdominal wall, the vaginal cuff, bladder, and pelvic floor. Related complications include pelvic abscess or infected

hematoma and sepsis. A patient's individual susceptibility to infection depends on a variety of factors including bacterial virulence, extent of surgery-related tissue trauma and fluid collection, the effectiveness of the patient's immune system, age, nutritional status, presence of diabetes, smoking, coexistent infection or colonization with microorganisms. Perhaps the most important factors in SSI prevention in hysterectomy are timely administration of appropriate preoperative antibiotics and meticulous surgical technique. Use of β -lactam alternatives in patients who do not report an anaphylactic reaction can lead to increased antimicrobial resistance. In fact, a retrospective cohort study involving over 21,000 women undergoing hysterectomy demonstrated that the use of standard β -lactam antibiotics had a lower risk of SSI compared to those who received an alternative regimen [23]. Thus, we advise judicious use of β -lactam alternatives for patients with a history of IgE-mediated penicillin hypersensitivity. The most common organisms isolated from vaginal cuff infections are anaerobes. In a large retrospective cohort study with over 18,000 patients undergoing hysterectomy of any type, those receiving cefazolin or a second-generation cephalosporin have more than double the SSI risk compared with those receiving combined treatment with cefazolin and metronidazole [25]. This is likely related to enhanced anaerobic coverage with the addition of metronidazole. We recommend that all patients undergoing hysterectomy receive metronidazole in addition to the standard intraoperative antibiotics.

3.4 Skin and vaginal preparation

The CDC also advises that the entire body be cleansed with either soap or antiseptic the night prior to the procedure. Intraoperatively, alcohol-based chlorhexidine is more effective for skin preparation when compared to iodine solutions [30, 31]. With regards to vaginal preparation, either povidone-iodine or chlorhexidine gluconate (4%) with a low concentration of isopropyl alcohol is acceptable, as both significantly reduce rates of postoperative infectious morbidity [32].

3.5 Post-hysterectomy care and precautions

In general, our practice will have patients return for short-term postoperative evaluation within 2 weeks following their hysterectomy. Patients are counseled to maintain pelvic rest for a minimum of 8 weeks. Postoperative blood and other secretions from the vaginal cuff may raise the vaginal pH and as a result, increase the risk of bacterial vaginosis. Many patients with vaginal cuff infections present more than 2 weeks following hysterectomy, which suggests a late ascending spread of vaginal microorganisms. As a result, our patients return for a second postoperative appointment and vaginal cuff check approximately 4–6 weeks after their hysterectomy.

4. Treatment

Gynecological surgical site infections are polymicrobial with a mix of both anaerobic and aerobic infections. Common pathogens contain gram-negative bacilli, enterococci, streptococci, and anaerobes—that is, *Staphylococcus aureus*, coagulase-negative staphylococci, and *Streptococcus* and *Enterococcus* species. When SSI is suspected, the wound should be thoroughly inspected. Surgical site infections are characterized as superficial, deep incisional, or organ/space. Involvement of the fascia and/or muscle with infection is the hallmark of a deep incisional SSI, whereas patients with organ/space SSI typically present with generalized malaise, fever, and pain. It becomes important to note that early recognition

of necrotizing soft tissue infection is crucial. These infections can manifest rapidly after surgery with Group A streptococcus and clostridia as the primary pathogens.

Wound exploration and debridement are pillars in the management of superficial and deep-incisional SSIs. This includes not only opening the wound, debridement of necrotic and devitalized tissue, but also involves the culture of the wound to allow for speciation of potential pathogens to assist in antibiotic therapy.

The mortality and morbidity of organ/space SSI tend to be higher than superficial or deep SSI. The primary objective in management is to achieve source control. Computed tomography and ultrasound are employed to guide placement of closed suction percutaneous drains into abscess collections when feasible. The initial approach in treatment of post-hysterectomy pelvic abscess depends on three factors: (1) hemodynamic stability, (2) abscess size, and (3) abscess location. Hemodynamically unstable patients require prompt surgical intervention and intensive care monitoring.

Patients who are hemodynamically stable with a post-hysterectomy pelvic abscess should be treated empirically with parenteral broad-spectrum antibiotics. Initial antimicrobial regimens can be tailored to subsequent culture and sensitivity results. If the patient does not respond within 48–72 hours, percutaneous drainage or infectious disease consultation may be warranted. An argument can be made for earlier percutaneous drainage. In fact, a systematic review comparing the success rates of 3 modalities of minimally invasive management of tubo-ovarian abscesses—laparoscopy, ultrasound-guided drainage and computed tomography-guided drainage—reported that better outcomes were achieved by the minimally invasive approach when compared with conservative management. Of these techniques, image-guided drainage provided the highest success rates, fewest complications, and shortest hospital stay compared to laparoscopy [33].

Treatment failure is defined as persistent fever, leukocytosis, pain or lack of abscess resolution. Risk factors include residual fluid collection after drainage and increasing patient age. Surgical management is recommended at this time.

5. Summary

The most common reason for unplanned readmission after surgery is surgical site infection. SSIs are associated with increased morbidity, mortality, transfer to an intensive care setting, prolonged hospitalization, hospital readmission, and increased healthcare costs. In addition, the development of SSI negatively impacts patient experience.

The majority of postoperative issues can be anticipated and prevented preoperatively. Systematically addressing these issues at the preoperative evaluation may result in greater patient satisfaction and fewer complications. Thus, prevention of SSI after hysterectomy begins with a calculation of perioperative risk followed by addressing those risk factors prior to the procedure. Intraoperative measures aimed at SSI prevention include the implementation of evidence-based SSI prevention bundles, proper administration of intraoperative antibiotic prophylaxis, and proper skin/vaginal preparation. Postoperatively, hysterectomy patients should be followed closely.

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