

Surgical Infections in the Gynecological Oncology Patient

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Abstract

Background: Gynecological cancer among the female population across the United States is on the rise. The American Cancer Society estimates about 94,000 women will be diagnosed with gynecological cancer each year in the United States. Surgical site infections account for the largest complication amongst gynecological oncology procedures.

Objective: With new surgical techniques, robotic assisted surgery is becoming the choice for surgeons across the country over the traditional laparotomy and open abdomen and pelvic procedures due to the rate of infection decreasing over the years. With cancer being one of the leading causes of death among humans in the United States, it is important to find surgical procedures that ensure patient safety and ensure clinical success. **Methods:** A review of the literature was conducted. The purpose of this paper is to explore research on surgical site infection rates and comparison of surgical procedures for gynecological oncology patients.

Conclusion: Operating room nurses play a key role in reducing surgical site infections in gynecological oncology patients. Nurse educators play a key role in providing the foundation of new evidence based knowledge to the operating room nurse.

Keywords: Surgical Infection; Robotic Assisted Surgery; Perioperative Nursing; Gynecological Cancer; Gynecological Oncology Surgery; Oncology Nursing

Introduction

"Gynecological cancer is on the rise in women across the United States" [1]. Surgical site infections account for the largest complication amongst gynecological oncology procedures. With new surgical techniques, robotic assisted surgery is becoming the choice for surgeons across the country over the traditional laparotomy and open abdomen and pelvic procedures due to the rate of infection decreasing over the years. Postoperative infection is a problem that surrounds operating rooms everywhere. Many hospital systems have surgical infection bundles in place that start with the patient at home and continue after their surgical procedure. Surgical site preparation, antibiotic prophylaxis, and certain wound closure techniques account for a decrease in surgical site infections. Oncology patients are at high risk for surgical site infections due to decreased nutrition, low white blood cell counts, and stress on the body. Comfort of the patient accounts for a part of decreasing surgical site infections in the gynecological oncology surgical patient.

Purpose of the Study

The purpose of this paper is to explore research on surgical site infection rates and comparison of surgical procedures for gynecological oncology patients.

Materials and Methods

The population for this literature review is individuals who underwent a surgical procedure for gynecological cancer diagnosis via laparotomy and robotic assisted surgery. The PICO that guided this review is, “In gynecological oncology surgical patient, how does minimally invasive surgery compared to open surgery affect surgical infection rates within one week postoperatively”. To answer this PICO research question, CINAHL, PubMed, and EBSCO search databases were used for up to date and relevant literature. When conducting research for this topic, key words used in the search engine such as surgical site infection, oncology, gynecology, robot-assisted surgery, and laparotomy. The use of these databases and key terms produced numerous research articles (n = 24) that describe that surgical infection rates in robotic assisted gynecological oncology procedures versus laparotomy procedures in gynecological oncology. Papers (n = 18) were chosen based on relevance to the PICO questions research in this paper.

Results and Discussion

Lisa Croke, managing editor for the Association of Operating Room nurses (AORN), wrote “preventing surgical site infections after gynecologic procedures”, which discusses the importance of prevention of infections in the operating room. “Surgical site infections (SSIs) are the most common complication associated with gynecologic surgery and include superficial incisional (vaginal cuff cellulitis), deep incisional (pelvic cellulitis), and organ/space (pelvic abscesses) infections. Hysterectomy, the most common gynecological procedure, has an SSI rate of approximately 2 percent” [1]. Patient risk factors for surgical site infections include smoking, obesity, perioperative hyperglycemia, low nutritional status, microorganisms present in the vagina, and blood loss more than 500 milliliters. In one study researched by AORN, a Surgical site infection bundle was used for hysterectomies, decreased the rate from 4.51% to 1.87%. Safety bundles aimed at preventing SSIs can be beneficial for patients undergoing gynecological oncological procedures.

Holly L. Steiner, MD., *et al.* discusses the pathophysiology and prevention of surgical site infections in gynecological oncology surgery. These infections represent high morbidity and mortality rates among patients.

The Center for Disease Control states that a surgical site infection occurs near the surgical infection within 30 days and can be extended up to a 12-month period after surgery. “SSIs arise from a complex interaction of several factors, including the type and number of contaminating bacteria, the virulence of those bacteria, and the resistance of the patient involved. Bacteria involved may originate from the host patient or arise from other sources, such as the surgical personnel, equipment, and the operating room environment. The presence of a foreign body, such as an implant or mesh, is also relevant, because studies have shown the “dose” of contaminating bacteria required to cause an infection is lower in the presence of foreign material” [2]. Steiner associated six perioperative measures that are associated with SSI risk, which included appropriate selection of prophylactic antibiotics, postoperative normothermia, oral antibiotics with mechanical bowel preparation, first postoperative day one glucose lower than 140, minimally invasive surgical approach, and short operative time under 100 minutes. In conclusion, several interventions can be used to decrease the occurrence of surgical site infections.

“Surgical and clinical safety and effectiveness of robot-assisted laparoscopic hysterectomy compared to conventional laparoscopy and laparotomy for cervical cancer: A systemic review and meta-analysis”, written by D.A. Park and colleagues aims its focus to cervical cancer; however, they discuss all gynecological cancers. Park states that “Most previous reviews showed that robotic-assisted hysterectomies (RH) reduced that operative time (OT), length of stay (LOS), rate of transfusion, and incidence of complications compared to open hysterectomy (OH) and decreased the LOS and estimated blood loss compared to laparoscopic hysterectomy (LH)” [3]. The discussion of this studied showed that the incidences of overall complications, wound infections, post-op fever, urinary tract infection and transfusion were significantly lower; whereas vaginal cuff complications was significantly higher in RH and OH. This research pulled together other studies to show intra-operative major complication, post-operative major complications, and minor complications when used RH versus OH. These included bladder injury, ureteral injury, cystotomy, vaginal complications, thromboembolism, ileus/bowel obstruction, wound

infections, post-operative fever, and urinary tract infection. The meta-analysis showed no significant differences in the complication rates between RH and OH. “The study demonstrated RH may have advantages in reducing overall complications including wound infection, fever, and urinary tract infections, LOS, blood loss, transfusions, and time to diet” [3]. A limitation noted in this study was that only non-randomized studies were included for evaluation, making justification difficult. One strength noted was a large intake of studies used to put information together for the meta-analysis with a large sample size of women receiving gynecological oncology surgical procedures.

“Vaginal prep in the operating room” written by Amy L. Roberson, BSN, MAED/AET, MSN, RN, Maj, USAF, CNOR focuses its research on the importance of sterile surgical preparation prior to each gynecological operation. For robotic-assisted surgery and open abdomen and pelvic cases (laparotomy), the abdomen and the vagina have a sterile prep prior to the beginning of the surgical procedure. In relation to surgical site infection rates, it speaks on the types of preparation solutions that should be used for each. For the vagina, the Center for Disease Control (CDC) and the Food and Drug Administration (FDA) recommends Povidone-iodine (PI) 10% solution for surgical prep with no dry time needed. In most hospital systems, 2% and 4% chlorhexidine gluconate solution are used due to lower cost and same overall effect. Per the FDA, chlorhexidine 4% is approved for these procedures, but are not approved for the genital areas at this time. If a patient has an allergy, baby shampoo can be used, but it is not approved. For the abdomen and all skin preparations, Chlorohexidine is the number one choice per the CDC and the FDA. Limitations included that literature is lacking vaginal prep studies. Agents used to prep the vagina in these procedures need more research to prove effectiveness on surgical site infection rates. Strengths of this article was the collective use of all available surgical prep agents and what they are approved for in gynecological procedures.

“The DISINFECT Initiative: Decreasing the Incidence of Surgical Infections in Gynecologic oncology”, written by Jolyn S. Taylor MD, MPH and colleagues researched an infection bundle that can be put together by a perioperative unit to reduce surgical site infection during gynecological oncology surgeries. “Development of Surgical Site Infections adversely affects health outcomes and is associated with increased morbidity and mortality among cancer patients” [4]. This bundle includes care in the preoperative, intraoperative, and postoperatively. One of the main focuses is on prophylactic antibiotics, like cefoxitin. These antibiotics can be taken in all three phases. This article explains how surgical site infections can include superficial skin and fascia, deep muscle, and organ space. The research for the bundle includes use of surgical site prep solutions, sterile instruments, use of a preoperative skin scrub, and wound site observation. “Implementation of the described bundled intervention significantly decreased the overall rate of surgical site infections from 12.5 to 7.4%” [4]. The article concludes that this can be an overall reduction of surgical site infections linked to gynecological malignancy surgical procedures. The limitations of this analysis were the detection of the surgical site infections were dependent on the staff on adequate documentation in the patient’s clinical record and this analysis could only assess the effect of the bundle and not the intervention as a whole. A strength of this study included the prospective review of all surgical cases in gynecological oncology for relevant feedback of this infection prevention bundle.

“Surgical Site Infections in Gynecology” by Jonathan D. Black, MD, MPH and colleagues speaks on the importance that surgical site infections are preventable in all patients. The Center for Disease Control (CDC) estimates that 1.9% of 16 million surgeries performed in the United States will become complicated from a surgical site infection. Black focuses research on patient characteristics, pre, intra, and postoperative infection prevention, and wound closure techniques in connection to surgical site infections. “Breaching the endocervix can introduce various pathogens into the cervix, the uterus, the fallopian tubes, and the abdomen” [5]. Patient characteristics associated with higher risk of surgical site infections include obesity, poor nutrition, comorbidities, and smoking. Infection prevention for gynecological oncology surgical procedures includes the use of the antibiotic cefoxitin 2g dosage during the surgical procedure, with the dosage beginning fifteen minutes prior to incision. The article speaks on levels of surgical site infections by tissue layer, which included superficial, deep incisional, and organ/space infections. Superficial is the most common area for infection, which includes the skin and subcutaneous tissue at the incisional site. Deep incisional infection includes the deep soft tissue (fascia and muscle) and organ/space infections can involve any part of the body.

With post-operative infection, the article defines it as “present with a fever, tachycardia, and leukocytosis at least 48 hours after surgery but more often at least 5 days postoperatively” [5]. Surgical site preparation prior to incision is a key competent in the decreased risk of surgical site infections.

Vahan Manvelyan, Veerapol Khemarangsarn, Kuan-Gen Huang, Aizura-Syafinaz Adlan, and Chyi-Long Li studied port-site metastasis (PSMs) in laparoscopic gynecological oncology surgery in 2015. Not only can this occur in laparoscopic procedures, but in robotic cases the port sites are used in the same surgical manner. The authors used a comprehensive systemic approach to research the major role played by biologically aggressive diseases, tumor manipulation, wound contamination, and other surgery related factors that can cause port-site metastasis in more than one study. The studies focused on 83 patients with endometrial (n = 39), ovarian (n = 29), and cervical (n = 14) cancers that received laparoscopic or robotic assisted surgical procedures. This study showed that the incidence of PSMs occurred in 2.3% of the patients. Manvelyan and colleagues summarized all studies used by saying out of 11,027 cancer patients receiving gynecological oncology laparoscopic or robot assisted procedures, the percent of PSMs occurred in less than 2% of the patients. “The following key factors may decrease the incidence of PSMs; a surgeon’s experience, correct and maximally atraumatical tumor manipulation and marcelation, tumor removal from the vagina, use of a impermeable bag, povidone-iodine irrigation of instruments, trocar, and port wound sites, and suturing of 10 mm and large trocar wounds” [6]. Advantages of laparoscopic and robot assisted gynecological oncology procedures continue to outweigh the disadvantages. A strength of the research is the author used multiple research articles with a large sample size to show the low occurrence of PSMs. One limitation was there was a need for more explanation of implementation of key factors to decrease the incidence of PSMs in patients.

The article “readmissions after major gynecologic oncology surgery” by Shitanshu Uppal, *et al.* from the University of Michigan Medical Center discusses the underlying indications, timing, and risk factors associated with hospital readmissions after major gynecological oncology surgeries. This study contained a total of 12,804 patients with a 6.5% (n = 832) readmission rate due to factors related to gynecological oncology procedures. Research concluded that each readmission was within two weeks of the surgical procedure. Analysis of the patient showed that African American patients, patients with a higher comorbidity score, higher ASA scores, discharge destination other than home (extended care facility, rehabilitation center), lower mean serum albumin, open surgical approach, or operative time longer than three hours, and patients with additional surgical procedures had higher rates of unplanned readmission rates. The other category Uppal and colleagues used was indications for readmissions of these patients. Infections, such as surgical site infections, accounted for 45% of the readmission rate. “Surgical Site Infections were the most common reason, accounting for 29.2% of all readmissions. Infections other than SSI (pneumonia, urinary tract infection, pyelonephritis, sepsis, septic shock, cellulitis) and GI causes (nausea, vomiting, dehydration, ileus, bowel obstruction, electrolyte abnormalities) were the two next most common indications accounting for 15.5% and 19.4% readmissions respectively” [7]. Indications proved that laparoscopic and robot assisted surgery contained the lowest surgical infection rates when compared to laparotomy surgery in the gynecological oncology patient. Strengths to the study include detailed information regards surgical site infection indication in this patient group and a large sample size. One Limitation to this study is a small demographic group. In order to reduce surgical site infections, it is suggested by this study to increase minimally invasive procedures and identify at risk population groups to reduce the rate of readmissions after major gynecological malignancy surgeries.

Rachel L. O’Donnell, Georgios Angelopoulos, *et al.* researched “Impact of surgical site infection (SSI) following gynecological cancer surgery”. This study focused on women receiving a laparotomy for suspected gynecological cancer in the United Kingdom. “Out of a study of 339 women, a clinical diagnosis of SSI was made in 54 (16%) women, 33% (18/54) of women had prolonged hospital stays, and 11/37 (29%) had their adjuvant treatment delayed or cancelled” [8]. Procedures used for data collection included hysterectomy, oophorectomy/salpingectomy, Omentectomy, pelvic lymph node dissection, para-aortic lymph node dissection, small bowel resection, large bowel resection, and peritoneal stripping with the use of a laparotomy technique. Infection prophylaxis is recommended for all patient receiving a laparotomy procedure in the pelvic and abdominal cavities due to high risk of exposure to bacteria. A strength noted of this study is it is the first research article to research current practice surrounding the prevention and management of SSI in open gynecological cancer

surgery. Limitations included data relating to direct and indirect healthcare costs of SSIs were not available and longitudinal data examining gynecological cancer specific outcomes were not available.

Surgical site infections (SSIs) remain a problem in surgical procedures despite continued advances in preoperative measure and aseptic technique. DJ Stinner, *et al.* [9] examined the effects of the use of chlorhexidine in surgical site preparation. This solution is commonly used in various concentrations, most commonly 4% in gynecological oncology procedures, both laparotomies, robotic-assisted, and laparoscopic. Stinner conducted research on three separate groups with the use of three different aqueous chlorhexidine gluconate solutions (group 1:4%, group 2:2%, and group 3:0.4%). This studied used a two-minute dry time when using all three different types with a decrease in bacterial load with 30% of the original bacteria remaining. "All three groups demonstrated significant reductions in bacterial load after the first and second minute of contact time, with the higher concentrations of aqueous chlorhexidine resulting in greater reductions" [9]. A limitation noted in this studied stated that chlorhexidine surgical preparation was not compared to other solutions or tested. A strength to this studied included the use of three groups and with the use of bacterial studies on each individual group. In conclusion, standard aseptic technique with surgical preparation should be continued in the intraoperative setting to minimize SSIs.

"Intensive postoperative glucose control reduces the surgical site infection rates in Gynecologic oncology patients" researched by Ahmed N. Al-Niaimi, *et al.* focuses research on patients with diabetes mellitus (DM) receiving gynecological cancer surgical procedures. Women (n = 372) were placed in three groups. Group one was composed of patients with DM who blood sugar was controlled with intermittent subcutaneous insulin injections, group two as patients who had DM and postoperative hyperglycemia with control of insulin infusion, and group three was composed of patient with neither DM or hyperglycemia. These three groups focused on surgical site infection rates. "Patients in group 2 had an SSI rate of 26/135 (19%), similar to patients in group 3, whose rate was 19/89 (21%). Both were significantly lower than the SSI rate (43/148, 29%) of patient in group 1. This reduction of 35% is significant (p = 0.02)" [10]. This study suggests the use of strict protocols for insulin infusion for patients receiving gynecological oncology surgical procedures who have DM. The use of insulin during surgical procedures to control blood glucose levels decreased surgical site infection rates significantly. A strength of this study is including a large number of patients in each of the three groups. A major limitation noted in this study was possible lack of collection of key cofounding factors that could affect the outcome of this study. The authors concluded that initiating intensive postoperative glucose control 24 hours after major gynecological oncology surgery lowers the SSI rate by 35% in patients with DM and hyperglycemia.

Complications related to gynecological oncology surgical procedures proposes a significant burden of harm in the United States and can cost up to \$25 billion. Melissa H. Lippitt, MD, *et al.* [11] researched "outcomes associated with a five-point surgical site infection prevention bundle in women undergoing surgery for ovarian cancer". 219 women were studied in the prospective quality improvement study. During the study period, 91 women were under the prebundle and 128 were treated in the postbundle period. "Overall the surgical site infection rate prebundle was 18 (20%); this was reduced to four (3%) postbundle". This 5-point surgical site infection prevention bundle was first implemented at Johns Hopkins. The elements included chlorhexidine wash using 4% chlorhexidine gluconate wipes and mechanical bowel preparation with oral antibiotics in the preoperative stage, antibiotic and skin preparation administration and adoption of enhanced sterile techniques during intestinal resection and wound closure intraoperatively, and strict postoperative wound management. Strengths of this study was the inclusion of a high-volume patient population undergoing gynecological oncology procedures and utilizations of evidence-based practice. A limitation of this study included adverse events that did not allow precise multivariate adjustments. In conclusion, the implementation of the 5-point bundle in women dramatically decreased infection rates and decreased hospital readmission rates.

Minimally invasive surgery (MIS) in gynecological oncology procedures are being implemented in hospitals across the United States. Zagnano, MD, *et al.* research "Robot-assisted surgical in gynecologic cancer". This research used many articles to support information on this topic. "Robotic-assisted surgery (RAS) has been used for patients with endometrial cancer and resulted in the increased use of

minimally invasive surgery with improved outcomes compared with laparotomy and partially with laparoscopy. This has been shown in large cohorts of patients as well as in obese patients in whom the complication rates have significantly decreased" [12]. Robotic-assisted surgery is associated with lower costs, decreased infection rates, decreased blood loss, and decreased hospital stay when associated with specific gynecological oncology procedures. One limitation is the research current on the use of robotic assisted surgery on patients needing hysterectomies. A strength for this study included the use of a wide variety of research articles and the use of evidence-based practice on decreasing surgical site infections with the use of RAS.

The level of relationships among the concepts are predictive because by identifying the unmet comfort needs of the patient, interventions are planned to meet those needs resulting in the desired outcome of enhanced comfort. Kolcaba's Comfort Theory, middle range nursing theory, focuses on how patients' unmet needs of comfort are optimally met by nurses during the stressful health situation that they are in. The comfort theory predicts improved patient outcomes by providing a framework for nurses to better conceptualize the patients' human comfort needs, and subsequently influence their environment so that therapeutic interventions may take place. This theory can be applied by nurses for the gynecological oncology patient due to the anxiety and unease of the patient preparing to receive surgery. There are many aspects of discomfort a patient may experience, in addition to physical discomfort, during the pre-operative and the post-operative phase. Patients may experience pain, and lack of warmth, but may also have physiological, psychological, environmental, and sociocultural components. Therefore, assessing the patient in relation to their health situation is essential to understanding the needs of the patient at that time. Types of comfort identified by Kolcaba [13] includes "relief, ease and transcendence", which occur physically and mentally. These types of comfort are experienced by the patient "physically, psycho spiritually, environmentally and sociocultural" in the healthcare setting. Pre-operative anxiety is a common discomfort and can have negative effect on the patient's ability to cope in their situation. Providing comfort through compassionate care will help to alleviate the negative symptoms experienced by the patient relevant to a gynecological oncology diagnosis. The comfort theory framework clearly explicates how to assess the patient within their unique situation and environment, thus enabling the nurse to choose comforting interventions resulting in positive patient outcomes. In addition to comfort, this theory enlightened the fact that an increase in positive patient outcomes also results in nurse satisfaction, decreased hospital length of stay, and decreased re-admissions leading to positive institutional outcomes. Using a theory specific to the practice setting can help to provide a positive change in the way that nurses provide holistic patient care based on the patient's individualized physical and emotional needs [14-18].

Conclusion

The articles in this literature review highlighted the importance of perioperative nursing staff awareness of surgical site infection risks in the gynecological oncology patient. Perioperative nurses need to be aware of the prevalence of surgical site infection rates and what can be done to decrease the rates in different hospital systems. When a patient develops a surgical site infection, the course of cancer treatments can be compromised, creating anxiety for the patient and family involved. Nurse educators in the perioperative department can train staff of prophylactic interventions to reduce the risk of surgical site infection for both laparotomy and robotic-assisted gynecological surgeries. Surgical site preparation is the job of the circulating nurse in the operating room. Nurses need to be trained and aware of different types of surgical site preps, dry times, and when to use one over the other. The implementation of an infection prevention bundle is key in the decreased rate of surgical site infection and decreased hospital stay for patients. Anesthesia staff need to be trained on the management of prophylactic antibiotics in the patient, as it should be administered 15 minutes prior to the first incision, along with the management of glucose during the course of the procedure. During this time the patient is asleep under general anesthesia, however the Kolcaba's comfort theory can be used to help decrease patient and family anxiety and decrease the risk of surgical site infections for these patients.

There are many aspects of discomfort a patient may experience, in addition to physical discomfort, during the pre-operative and the post-operative phase. Patients may experience pain, and lack of warmth, but may also have physiological, psychological, environmental, and sociocultural components. The operating room is a different environment than many other units. The nurse can manage a patient's

environment to make them more comfortable by decreasing noise, interruptions in the room, clutter and trash, and lighting and heating issues. This can be done is the pre-operative stage prior to putting the patient asleep. Surgical site infections can occur from stress on the body. Nurses and other staff members can help ease the patient's mind and give relief to help the body have decreased stress during healing after surgery. Evidence-based practice can be used to comfort the patient, along with educating the perioperative team and nurses on post-surgical floors the surgeons and symptoms of surgical site infection. Operating room nurses play a key role in the care of gynecological oncology surgical patients. With the use of new evidence- based practice, nurse educators, and the surgical team, surgical site infections and comfort for patients can be achieved.

Conflict of Interest

The authors have no financial interest or conflict of interest.

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