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RESEARCH ARTICLE

Rate and Risk Factors for Surgical Site Infection in Gynecologic Oncology Surgeries at a Tertiary Care Facility in a Developing Country

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ABSTRACT

Introduction: Surgical site infections (SSIs) are among the most common complications in surgical patients and have serious consequences for outcomes and costs. There is a dearth of information on risk factors for developing SSI in patients undergoing gynecologic cancer surgery, and this has not been studied using national data.

Objectives: The objectives of this study were to estimate the prevalence, preoperative and operative risk factors associated with the higher risk of SSIs in gynecologic cancer patients undergoing surgery in a tertiary care facility in a developing country.

Setting: Department of Obstetrics and Gynaecology, Aga Khan University Hospitals, Karachi, Sindh, Pakistan.

Materials and methods: Retrospective record review of gynecologic oncology patients admitted for surgery from January 2015 to December 2015 was performed.

Results: A total of 100 patients met the inclusion criteria. Of these, 15 were identified with SSIs, which were all found to be of the superficial type. Approximately, 44, 40, and 7% were diagnosed with endometrial, ovarian, and cervical cancers respectively. The mean time from surgery to developing SSI was 12.9 days. Among endometrial cancer, 22.7% (10/44) had SSI compared with 7.5% (3/40) for ovarian cancer and 14.2% (1/7) for cervical cancer. The significant predictors of SSI were body mass index ≥35 (p-value <0.004), endometrial cancer diagnosis, the American Society of Anesthesiologists class more than 3, modified surgical complexity scoring system 3 to 4, and blood sugar levels more than 180 mg/dL within 48 hours after surgery in known diabetics.

Conclusion: About 15% of patients undergoing laparotomy for gynecologic malignancy developed SSIs. In this study, we identified several risk factors for developing SSI among gynecologic cancer patients. These findings may contribute toward identification of patients at risk for SSIs, and the development of strategies to reduce SSI rate and potentially reduce the cost of care in gynecologic cancer surgery.

Keywords: Gynecologic oncology, Minimally invasive surgery, Surgical site infections.

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INTRODUCTION

Surgical site infection (SSI) is one of the most common health care-associated infections (HAIs), estimated to account for 18.6% of inpatient HAI within National Health Service.[1] The SSI is reported to cause excess morbidity, mortality, and increased length of stay.[2] The SSIs have serious consequences for patients affected, as they can result in excess pain, suffering, and in some cases require additional surgical intervention.[3] The two key aims of SSI surveillance are to provide participating hospitals with robust SSI rates for benchmarking and to use collected data to improve the quality of patient care. Evidence suggests that actively feeding back data to clinicians contributes to reductions in rates of infection.[4]

A standardized definition of SSIs was published by the Surgical Wound Infection Task Force USA in 1992, according to which, SSIs were defined as the presence of purulent drainage; spontaneous drainage of fluid from the wound, regardless of whether it is culture positive for bacteria or not; localized signs of infection for superficial sites or radiological evidence of infection for deep sites; an abscess or other type of infection on direct surgical exploration; or a diagnosis of an infection by a surgeon.[5] Furthermore, SSIs have been categorized by the US Centers for Disease Control and Prevention (CDC) into superficial, deep, and organ/space infections.[5] Superficial infections involve the skin or subcutaneous tissue; deep infections involve the muscle or fascia; and organ/space infections involve the body cavity, such as the pleural cavity or liver bed.[6] The National Research Council, USA developed a system for categorizing incisions based on the degree of contamination of the

Table 1: US National Research Council categorization of incisions 7 and 8

Category	*Definitions*	*Examples*	*Expected infection rate*
Clean	Wounds that are nontraumatic and/or do not enter the digestive, respiratory, or genital urinary tracts. These cases involve only the skin and sterile body spaces without breaks in sterile technique	Breast surgery, inguinal hernia repair, carpal tunnel release	1–5%
Clean–contaminated	Wounds in which the digestive, respiratory, or genitourinary system is entered, without visible contamination and without obvious infection. These cases involve nonsterile viscera, which have a relatively low level of bacterial colonization	Biliary surgery, bowel surgery with prepared bowel, hysterectomy, tonsillectomy	5–10%
Dirty	Wounds in which there is visible contamination from a hollow viscous or are clinically infected. These cases involve exposure to high levels of bacteria	Excision of perforated appendix/bowel, drainage of abscess	10–40%

incision.[7,8] The original classification was based on four categories: Clean, clean–contaminated, contaminated, and dirty; but the contaminated and dirty categories were later amalgamated and are referred to as "dirty" (Table 1).[9,10]

The American Society of Anesthesiologists (ASA) scores are categorized into five classes: Class I is normal healthy person; class II is patient with mild systemic disease; class III is patient with severe systemic disease that limits activity, but is not incapacitating; class IV is patient with an incapacitating systemic disease, i.e., a constant threat to life; and class V moribund patient, who is not expected to survive 24 hours with or without surgery.[11]

Many health care providers and organizations, such as the US CDC, the Joint Commission on Accreditation of Health care Organizations, and the Surgical Infection Society consider that periodic audits of postoperative nosocomial infections should be mandatory because surveys of this nature decrease infection rates by raising awareness of the issue.

Given its associated morbidity and increased costs, identifying risk factors for SSI is important, and has been the focus of surgical research. The information on risk factors for developing SSI in patients undergoing gynecologic cancer surgery is limited and has not been studied locally elsewhere. Therefore, the objectives of this study were to estimate the prevalence, preoperative and operative risk factors associated with the higher risk of SSI in gynecologic cancer patients undergoing surgery in a tertiary care facility in a developing country.

MATERIALS AND METHODS

Data Source

The Aga Khan University Hospitals (AKUH), Karachi, Sindh, Pakistan, is a tertiary care facility with obstetrics/gynecology being a well-established domain along with its subspecialties including gynecologic oncology. In our study, a systematic retrospective review of all the confidential medical record files of the gynecologic oncology surgeries being done over a period of 1 year, i.e., January 2015 to December 2015, was done. The study was exempted from Ethical Review Committee of hospital as per institutional guidelines. A total of 130 cases were included.

Surgeries not involving an incision, such as hysteroscopy, examination under anesthesia, and biopsies were excluded. For each case, inpatient and outpatient charts were reviewed to record the study variables as mentioned in the study proformas. The type of procedure and the degree of contamination of each case were determined from the operative report. The ASA score and the comorbidity factors were collected from admission histories, anesthesia records, and discharge summaries. The SSI was labeled if the records revealed any of the following: Opening of the wound; pain, tenderness, and raised temperature of skin; purulent discharge from the wound; and if the surgeon had documented it as an SSI. The minimum postoperative follow-up for any case was 30 days. All the findings were recorded in study proformas.

The extent of surgical intervention was categorized into modified surgical complexity scoring (MSCS) system (Table 2).

Table 2: Modified surgical complexity scoring system

Surgical complexity scoring	1	Hysterectomy or salpingo-oophorectomy or both
	1	Lymphadenectomy
	1	Omentectomy
	2	Bowel resection (small or large)
	2	Gastrectomy
	2	Splenectomy
	2	Hepatectomy
	2	Pancreatectomy
Modified surgical complexity scoring	Mild	≤2
	Moderate	3–4
	Severe	>4

Outcome

The primary outcome was SSI within 30 days of surgery. Secondary outcomes were determining independent predictors of SSI, which may include primary cancer diagnosis, obesity, ascites, preoperative anemia, ASA class ≥3, MSCS ≥3, and perioperative blood transfusion.

Statistical Analysis

Data analysis was done using Statistical Package for the Social Sciences version 16 (Chicago). Continuous variables were analyzed as means ± standard deviations and analyzed by independent sample t-test. Categorical variables were analyzed as frequencies and percentages. Chi-square test was applied to determine the association between SSI (dependent variable) and risk factors; $p \leq 0.05$ was considered as significant.

RESULTS

A total of 100 patients met the inclusion criteria. A detailed review was conducted of the preoperative and operative details of surgeries, and the follow-up visits afterward until 30 days.

Characteristics of study patients are presented in Table 3.

Table 3: Characteristics of study patients

Variables	*Point estimation*
Age (years)	53.38 ± 12.05
Weight (kg)	153.89 ± 11.12
Height (cm)	73.52 ± 20.61
BMI (kg/m^2)	35.16 ± 49.23
ASA – I/II/III	8%/65%/27%
Wound class	
Clean–contaminated	91%
Clean	9%
Anesthesia	
General	73%
General and epidural	27%
Drain used	89%
Transfusion	25%
Type of cancer	
Endometrial cancer	43%
Ovarian cancer	40%
Cervical cancer	7%
Other	10%
Procedures	
Hysterectomy	
Total	93%
Radical	3%
Salpingo-oophorectomy	96%
Omentectomy	82%
Lymphadenectomy	91%
Vulvectomy	1%
Appendectomy	4%
Bowel surgery	5%

Median age of patients admitted for surgery was 52 to 56 years. The median body mass index (BMI) of study patients was 29 to 35 kg/m^2, and it was found to have a significant p-value (<0.004) in terms of positive SSIs in patients with BMI around 35 kg/m^2. Among ASA class III patients, more than half were observed to have signs of superficial SSI. Perioperative blood and blood products transfusion, use of pelvic or peritoneal drains, and duration of surgical procedure were not found to have a significant impact on development of SSI later on. Most of the surgical procedures fall under the category of MSCS of around 3, but the complexity of surgical procedure was not found to have a significant association with development of SSI.

About 15 patients were identified with SSI within 30 days of surgery, which were all found to be of the superficial type as depicted in Graph 1.

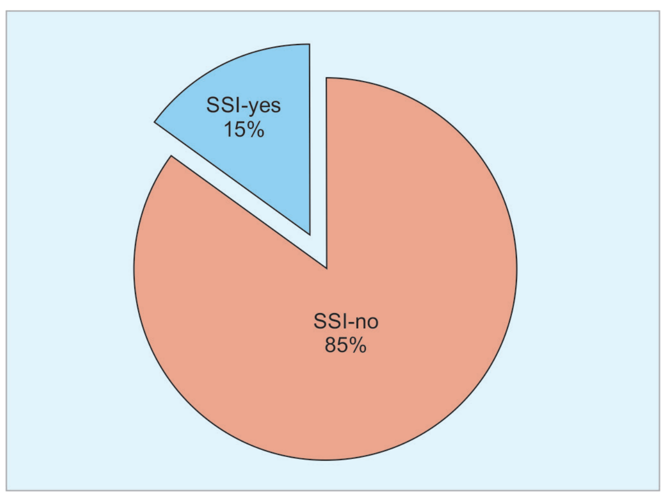
Table 4 presents the predictors of SSI.

Approximately 44, 40, and 7% were diagnosed with endometrial, ovarian, and cervical cancers respectively. The mean time from surgery to developing SSI was 12.9 days. Among endometrial cancer, 22.7% (10/44) had SSI compared with 7.5% (3/40) for ovarian cancer and 14.2% (1/7) for cervical cancer, thus developing some association between endometrial cancer and development of SSI in these patients, which needs to be clarified further by more studies.

Another important factor is the blood sugar control in known diabetics in the immediate postoperative period, which highlighted the importance of glycemic control, i.e., maintaining levels below 180 mg/dL within 48 hours after surgery, as higher levels were found to be associated with SSI in these patients.

DISCUSSION

Surgery is the cornerstone of treatment for gynecologic malignancies; therefore, a gynecologic oncologist may



Graph 1: The SSIs within 30 days of surgery

Table 4: Comparison of risk factors to predict SSI

	Surgical site infection		
Variables	*Yes n = 15*	*No n = 85*	*p-value*
Age (years)	56.6 ± 14.16	52.81 ± 11.65	0.26
BMI (kg/m^2)	35.57 ± 9.43	29.36 ± 7.07	0.004
ASA			0.97
I and II	11 (73.3%)	62 (72.9%)	
III	4 (26.7%)	23 (27.1%)	
Duration of procedure			0.58
3–5 hours	7 (46.7%)	51 (60%)	
>5 hours	5 (33.3%)	19 (22.4%)	
Transfusion	4 (26.7%)	21 (24.7%)	0.87
Type of cancer			0.23
Endometrial cancer	10 (66.7%)	33 (38.8%)	
Ovarian cancer	3 (20%)	37 (43.5%)	
Cervical cancer	1 (6.7%)	6 (7.1%)	
Other	1 (6.7%)	9 (10.6%)	
Procedures			
Hysterectomy			
Total	14 (7.1%)	79 (6.7%)	0.95
Radical	1 (6.7%)	2 (2.4%)	0.39
Salpingo-oophorectomy	15 (100%)	81 (95.3%)	0.39
Omentectomy	13 (86.7%)	69 (81.2%)	0.61
Lymphadenectomy	15 (100%)	76 (89.4%)	0.34
Vulvectomy	0 (0%)	1 (1.2%)	0.99
Appendectomy	1 (6.7%)	3 (3.5%)	0.48
Bowel surgery	1 (6.7%)	4 (4.7%)	0.56

encounter a number of postoperative SSIs throughout their career.[12-14] The importance of reducing these SSIs cannot be overstated in modern day health care. The goal to reduce SSIs is twofold: One, to limit the patient's morbidity and two, to reduce the costs of health care by decreasing readmission rates and limiting prolonged hospital stays. In the former, SSIs can result in significant morbidity and mortality for the gynecologic oncology patient, imposing additional suffering to an individual who already carries a morbid diagnosis.[15] The SSIs in these patients may prolong hospital stays, introduce antimicrobial resistant bacteria, expose patients to medication reactions/errors, and, more importantly, may even lead to decreased overall survival.[16-17] This is evidenced in a retrospective review of 888 gynecologic oncology patients who underwent primary surgery for ovarian cancer. In the study, increasing BMI, operative time, and advanced stage disease were independently associated with SSIs, which, in turn, led to a decrease in overall survival.

With the goal of reducing SSIs, there has been an interest in implementing new strategies for its elimination. One such strategy has been the introduction of "bundled interventions" in the perioperative time frame. Johnson et al[18] proposed the use of "bundled interventions" in gynecologic oncology patients undergoing laparotomies for surgical staging.

In these context, bundled interventions include use of a chlorhexidine gluconate shower prior to surgery, chlorhexidine gluconate, or povidone iodine skin preparation in the operating room, prophylactic use of IV antibiotics are part of care for all the preoperative surgical patients at AKUH.

The BMI greater than 35 was found to have a significant association with the development of SSI in these patients. A difference in the rate of SSI based on the cancer site of origin among patients who underwent open laparotomy for gynecologic malignancies, particularly with endometrial cancer, was observed, but it was not statistically significant. Higher ASA class was a risk factor for SSI among our laparotomy patients, confirming prior reports.[19-24]

Potential explanations for the link between SSI and obesity include increased thickness of poorly vascularized subcutaneous adipose tissue layer, local tissue trauma resulting from excessive retraction, and higher bacterial density at abdominal or groin creases. Therefore, careful attention to closure technique and proper choice and dosing of prophylactic antibiotics might be helpful in lowering the incidence of SSI in obese patients. Furthermore, our study confirmed the predictive capability of ASA classification for risk of SSI. Patients with higher ASA class were at higher risk for SSI.

Several studies have shown that stricter postoperative glycemic control lowers the risk of SSI in diabetic patients. Talbot[25] showed that not only is diabetes mellitus (DM) an independent risk factor for developing SSI, but a higher postoperative blood glucose (>250 mg/dL) was associated with a higher SSI rate (3.7%) compared with a rate of 0.6% in patients with a blood glucose<150 mg/dL. We also observed an association between DM and SSI, particularly in those diabetics who had a blood glucose level more than 180 mg/dL within 48 hours postoperatively.

The significant predictors of SSI were BMI ≥35, endometrial cancer diagnosis, ASA class 3, MSCS 3 to 4, and blood sugar levels >180 mg/dL within 48 hours after surgery in known diabetics.

CONCLUSION

About 15% of patients undergoing laparotomy for gynecologic malignancy developed SSI. In this study, we identified several risk factors for developing SSI among gynecologic cancer patients. These findings may contribute toward identification of patients at risk for SSI, and the development of strategies to reduce SSI rate and potentially reduce the cost of care in gynecologic cancer surgery.

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