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Major Article

Surgical site infections in women and their association with clinical conditions

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ABSTRACT

Introduction: Surgical site infections (SSIs) can affect body tissues, cavities, or organs manipulated in surgery and constitute 14% to 16% of all infections. This study aimed to determine the incidence of SSIs in women following their discharge from a gynecology outpatient clinic, to survey different types of SSIs among women, and to verify the association of SSIs with comorbidities and clinical conditions. **Methods:** Data were collected via analytical observation with a cross-sectional design, and the study was conducted in 1,026 women who underwent gynecological surgery in a teaching hospital in the municipality of Teresina, in the northeast Brazilian State of Piauí, from June 2011 to March 2013. **Results:** The incidence of SSIs after discharge was 5.8% among the women in the outpatient clinic. The most prevalent surgery among the patients was hysterectomy, while the most prevalent type of SSI was superficial incisional. Comorbidities in women with SSIs included cancer, diabetes mellitus, and hypertension. **Conclusions:** Surveillance of SSIs during the post-discharge period is critical for infection prevention and control. It is worth reflecting on the planning of surgical procedures for patients who have risk factors for the development of SSIs.

Keywords: Surgical wound infection. Epidemiological surveillance. Hospital discharge. Gynecological surgical procedures.

INTRODUCTION

Surgical site infections (SSIs) can affect body tissues, cavities, or organs manipulated in surgery, and diagnosis is based on clinical and laboratory criteria. SSIs can manifest within 30 days after a surgical procedure or even up to a year with prosthesis implantation[1].

Surgical site infections have the third highest incidence among the types of infections that afflict hospitalized patients, comprising 14% to 16% of total infections. SSIs are classified as superficial incisional, deep incisional, and organ or space. The first type affects only the skin or subcutaneous tissue of the incision site; the second type involves deep structures of the wall, fascia, and muscle layer; and the third type affects any part of the anatomy that is opened or manipulated during the surgical procedure, with the exception of a wall incision[1].

SSIs increase the rate of rehospitalization; the use of health care, diagnostic, and therapeutic resources; and hospital costs. The shorter the hospitalization time is for surgery, the lower the risk of infection is[2,3]. Therefore, it is necessary to develop a safe and reliable method for monitoring the occurrence of SSIs after hospital discharge, as SSIs are an indicator of hospital performance. However, the precise monitoring of SSIs outside the hospital is not easy because monitoring post-discharge surgical patients is not efficient and patients often do not return for follow-up evaluations.

In one study conducted at a general hospital in Mexico, the prevalence of SSIs following gynecological procedures was greatest for abdominal hysterectomy (3.3%), gynecologic laparotomy (1.3%), and gynecologic/obstetric surgery (1.1%)[4]. A study in Brazil revealed the following data regarding rates of infection following gynecological surgery: 6.8% of patients at the University Hospital of the College of Medicine of Botucatu[5], 1.14% of patients according to the Hospital Infection Surveillance System of the State of Sao Paulo[6], and 10% of patients undergoing total abdominal hysterectomy[7].

Notably, the risk factors for the development of SSIs may be related to the patients and the surgical procedures themselves. According to Mangram et al.[8], the main risk factors related to patient characteristics are age, poor nutritional status, diabetes mellitus, smoking, infectious focus at a distance, altered immune response, and long preoperative stays[8].

Extrinsic factors include preparation of the patient's skin and staff surgical scrubs before surgery, surgery time and technique, surgical staging environment, and processing of materials and medical and hospital items[9-12].

The present study aimed to determine the incidence of SSIs among women after discharge from a gynecology outpatient clinic, survey types of SSIs (superficial incisional, deep incisional, and organ or space) among women, and verify the association of SSIs in women with comorbidities and clinical conditions.

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METHODS

Study type

Data were collected via analytical observation with a cross-sectional design, and the study was conducted in 1,026 women who underwent gynecological surgery in a teaching hospital in the municipality of Teresina, in the northeastern Brazilian State of Piauí, from June 2011 to March 2013. Study participants were evaluated in the gynecology outpatient clinic of the hospital. The inclusion criteria were as follows: having undergone gynecological surgery at the teaching hospital, hospitalization time longer than 24h, absence of prosthesis implantation, outpatient monitoring for 30 days, and agreement to participate in the study.

The gynecology outpatient clinic provides medical and surgical care in the specialty fields of gynecology and mastology. The most prevalent surgical procedures are abdominal or vaginal hysterectomy, oophorectomy, salpingoplasty, and gynecological laparotomy.

Data collection

Data were collected in two phases. The first phase was conducted in person between the 7th and 10th postoperative days and consisted of surgical wound evaluation and stitch removal, followed by the completion of an inquiry/notification form. The second phase occurred in person or by telephone, between the 12th and 30th postoperative days, and consisted of another surgical wound evaluation and completion of the inquiry form. During data collection, an extension of post-operative days was sometimes required, including after day 35.

This study adopted the U.S. Centers for Disease Control and Prevention and the Brazilian National Health Surveillance Agency definitions of SSIs; specifically, they were defined as infections occurring in the surgical incision or tissue manipulated during surgery that were diagnosed within 30 days of the procedure. For the diagnosis of SSIs, a classification scheme was utilized based on the depth reached by the infection: superficial incisional, deep incisional, and organ or space.

Collection (sampling) of secretions in the surgical wounds was performed with a sterile cotton swab according to the technique used by Levine. The samples were sorted by patient and type of surgical procedure. After collection, the samples were immediately transported to a microbiology laboratory. Identification of pathogens and antibiotic sensitivity tests were performed to evaluate the resistance of these microorganisms.

RESULTS

Of the surgeries performed on the women at the clinic, 5.8% of the study population (of a total of 1,026 patients) developed SSIs. The diagnosis of SSIs occurred between the 5th and 18th postoperative days. According to the demographic data, the majority of the women were in the age range of 25 to 44 (44%) years, followed by 45 to 64 (39.8%) years. The highest incidence of SSIs was observed among women aged 45 to 64 (35%) years. Approximately 60% of the participants were from Teresina, the state capital; 63% were married; 61% had completed elementary school; and 46% reported a family income of one minimum monthly wage (approximately US$280).

Table 1 presents the characteristics of the target population that developed SSIs; it was observed that 81.1% of these women were hospitalized for three days, and the most common surgery performed was abdominal hysterectomy (71.7%), followed by oophorectomy (15%).

The most prevalent characteristics of the surgical wounds of women with SSIs (i.e., symptoms and signs of SSIs) were

TABLE 1 - Clinical characterization of the study population (n = 60). Teresina, State of Piauí, June 2011 to March 2013.

	Number	Percentage
Length of hospital stay (days)		
2	2	3.3
3	49	81.7
≥ 4	9	15.0
Surgery type		
abdominal hysterectomy	43	71.7
colpoperineoplasty	1	1.7
vaginal hysterectomy	1	1.7
exploratory laparotomy	3	5.0
leiomyomectomy	2	3.3
oophorectomy	9	15.0
salpingoplasty	1	1.7

draining purulent secretions (83.3%), localized pain (73.3%), redness (68.3%), bruising (63.3%), and swelling (40%). The type of SSI with the highest prevalence was superficial incisional (73.3%), followed by deep incisional (26.7%), as shown in **Table 2**.

Of the 60 women diagnosed with SSIs, four types of microorganisms were identified, the most common of which was *Staphylococcus aureus,* as shown in **Table 3**. Cultures of surgical wound secretions were performed for 17 women, corresponding to 28.3% of the patients.

Among the women in this study, 16%, 7.9%, and 3% reported having hypertension, diabetes, and gynecologic cancer, respectively, and 4% were smokers. After multivariate logistic regression analysis **(Table 4)** of the study population, bivariate analysis showed that these variables were significantly associated with SSIs, with a risk similar to the risks in patients with cancer and those who smoke.

DISCUSSION

The SSI incidence rate identified during follow-up in the patients under surveillance represents an important source of information that should be disseminated with the goal of implementing prevention and control actions. In this study, the incidence of post-discharge SSIs in the women surveyed was 5.8%. At the university hospital of the College of Medicine of Botucatu, 62.2% of gynecological SSIs began after hospital discharge[5]. Thus, post-discharge monitoring after surgical procedures contributes to increased reporting of SSI incidence. Between 12% and 84% of infections are detected after patients leave the hospital[13-15].

The relationships between age, hysterectomy, and SSIs are frequently reported in the literature and are attributable to immunosenescence during the physiological process of aging, which increases the risk of infection. Studies confirm that women aged 50 years and over have a 3-fold higher risk of SSIs than younger women[16-19]. In this study, of the 60 women who developed SSIs, 27 (45%) were elderly; however, the results revealed no statistical associations.

In a post-discharge surveillance of general and cardiac surgery patients, when assessing surgical wounds, the signs and symptoms of SSIs in patients were pain, local erythema, change in odor, fever and purulent discharge, presence of dehiscence, serosal secretion, and swelling[12,19]. Similar clinical signs were observed in the present study this study, such as purulent discharge, localized pain, bruising, and swelling.

TABLE 2 - Type of surgical site infection and surgery performed (n = 60). Teresina, State of Piauí, June 2011 to March 2013.

	Type of SSI					
	SSI1		SSI2		Total	
Surgery performed	n	%	n	%	n	%
Colpoperineoplasty	1	100.0	0	0.0	1	100.0
Hysterectomy	30	69.8	13	30.2	43	100.0
Vaginal hysterectomy	1	100.0	0	0.0	1	100.0
Laparotomy	2	66.7	1	33.3	3	100.0
Myomectomy	2	100.0	0	0.0	2	100.0
Oophorectomy	7	77.8	2	22.2	9	100.0
Salpingectomy	1	100.0	0	0.0	1	100.0
Total	44	73.3	16	26.7	60	100.0

SSI: surgical site infections; **SSI1**: superficial incisional; **SSI2:** deep incisional.

TABLE 3 - Distribution of isolated microorganisms from secretion-derived cultures (n=17). Teresina, State of Piauí, June 2011 to March 2013.

	Cultures	
Microorganisms	n	%
Staphylococcus aureus	12	66.7
Staphylococcus coagulase-negative	2	11.1
Pseudomonas aeruginosa	3	16.7
Acinetobacter baumannii	1	5.5

TABLE 4 - Multivariate logistic regression analysis based on the presence of SSIs (n=1026). Teresina, State of Piauí, June 2011 to March 2013.

Variables	OR_{crude}	95% CI	$OR_{adjusted}$	95% CI
Age*			1.025	1.002-1.048
Post-operative time (days)*			0.853	0.789-0.923
Income				
no income	0.235	0.067-0.832	0.299	0.071-1.263
1 MW	0.625	0.218-1.872	0.692	0.192-2.495
2 MW	0.240	0.069-0.828	0.442	0.106-1.834
≥ 3 MW	1		1	
Nutritional classification				
low weight	2.417	1.008-5.794	2.316	0.849-6.319
eutrophic	1.187	0.660-2.134	1.270	0.660-2.442
overweight/obese	1		1	
Cancer				
yes	7.850	3.560-17.308	8.329	3.217-21.564
no	1		1	
Chronic vascular disease				
yes	4.076	0.449-37.047	1.635	0.154-17.375
no	1		1	
Diabetes *mellitus*				
yes	5.041	2.698-9.418	3.371	1,610-7.061
no	1		1	
Hypertension				
yes	3.074	1.757-5.377	2.082	1.064-4.075
no	1		1	
Smoking				
yes	3.316	1.412-7.789	3.506	1.284-9.574
no	1		1	

SSI: surgical site infections; **OR:** odds ratio; **95%CI:** confidence interval of 95%; **MW:** minimum wage. *Treated as a continuous variable.

In this study, most of the surgeries performed were abdominal hysterectomies (71.7%), and the type of SSI with the highest incidence was superficial incisional; deep incisional infections were the most common SSIs among patients with diabetes mellitus. In one study at Yale University, the Program for Improvement of Surgical Quality analyzed 13,822 women who underwent hysterectomy (abdominal or vaginal); 1.6% of the patients had superficial incisional SSIs, and 1.1% had deep, superficial, or organ organ-space incisional SSIs (n = 154 women). The women remained under surveillance for 30 days after surgery, and an infection incidence rate of 2.7% after hysterectomy was reported[20]. Previous studies have shown that abdominal hysterectomy is more invasive than vaginal hysterectomy and is associated with a lower risk of infection and associated costs[21,22].

Studies have shown that aerobic Gram-negative and Gram-positive bacteria are common after potentially contaminated and contaminated procedures, including gynecological and obstetric procedures[10,23,24]. Post-surgical gynecologic infections are primarily caused by endogenous bacteria. *Staphylococcus aureus* was the prevalent microorganism in this study and is an aerobic Gram-positive cocci that is an important cause of nosocomial infections. This highly virulent microorganism colonizes as part of the normal flora of the skin and mucous membranes of humans, especially those who work as health care professionals, i.e., people who could be sources of infection for susceptible individuals[25].

Therefore, epidemiological surveillance measures are indicators adopted to minimize the transfer of this microorganism and thus reduce the risk of SSIs.

Our results indicated that the comorbidities related to the development of infection were diabetes mellitus, hypertension, cancer, smoking, obesity, and chronic vascular disease. In the logistic regression analysis, age, number of days after surgery (postoperative time in days), cancer, diabetes mellitus, hypertension, and smoking were associated with SSIs. Other studies with similar results have shown that the comorbidities most frequently associated with SSIs are hypertension, heart disease, smoking, diabetes mellitus, cancer, and body mass index ≥ 40 kg/m^2[2,10,12,20,26]. Diabetes mellitus is an important factor in the occurrence of surgical wound infections, because it is a condition that causes vascular and neuropathic complications and decreases defense mechanisms[27-29].

The estimated incidence of post-discharge SSIs was possibly attributable to the implementation of surveillance through an active search for patients recently discharged from an outpatient gynecology clinic. The most common surgery was abdominal hysterectomy, while the prevalent type of SSI was superficial incisional. According to studies reviewed and discussed herein, superficial incisional infections have a higher incidence rate but are easier to resolve from a clinical perspective, which is important given the underreporting of this type of infection.

Comorbidities are present in women and are associated with SSIs, a fact that reinforces the need for post-discharge surveillance to facilitate the adoption of measures necessary for infection control.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

REFERENCES

1. Agência Nacional de Vigilância Sanitária (ANVISA). Assistência Segura: Uma Reflexão Teórica Aplicada à Prática. Vigilância e Monitoramento em Serviços de Saúde (GVIMS). Gerência Geral de Tecnologia em Serviços de Saúde (GGTES). Série Segurança do Paciente e Qualidade em Serviços de Saúde. Brasília (DF); 2013.
2. Martins MA, França E, Matos JC, Goulart EMA. Post-discharge surveillance of children and adolescents treated for surgical site infections at a university hospital in Belo Horizonte, Minas Gerais State, Brazil. Cad Saude Publica 2008; 24:1033-1041.
3. Ferreira FAPB, Marin MLG, Strabelli TMV, Carmona MJC. Ways the anesthesiologist can contribute to the prophylaxis of infection in the surgical patient. Rev Bras Anestesiol 2009; 59:756-766.
4. Garcia RB, Delagado ML, Kuba EB, Cabello RR, Chessin A, Rendón JC. Infección del sitio quirúrgico. Experiencia de dos años en el servicio de ginecología y obstetricia del Hospital General de México. Ginecol Obstet Mex 2006; 74:260-264.
5. Gomes AEB, Cavalcante RS, Pavan ECP, Freitas ES, Fortaleza CMCB. Predictive factors of post-discharge surgical site infections among patients from a teaching hospital. Rev Soc Bras Med Trop 2014; 47:238-238.
6. Assis DB, Madalosso G, Ferreira AS, Yassuda YY, Polachini ZM. Surveillance System for Hospital Infections in the State of São Paulo in 2011. BEPA 2012; 9:15-23.
7. Amorim MMR, Santos LC, Guimaraes V. Risk Factors for Infection after Total Abdominal Hysterectomy. Rev Bras Ginecol Obstet 2000; 22:443-448.
8. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for prevention of surgical site infection. Infec Control and Hosp Epidemiol 1999; 20:247-278.
9. Anderson DJ, Kaye SK, Classen D, Arias KM, Podgorny K, Burstin H, et al. Strategies to prevent surgical site infections in acute care hospitals. Infect Control and Hosp Epidemiol 2008; 29 (supl 1):51-61.
10. Lichtenfels E, Frankini AD, Paludo J, d'Azevedo PA. Prevalence of bacterial resistance in surgical wound infections in peripheral arterial surgery. J Vasc Bras 2008; 7:239-247.
11. Torres LM. Readmissão por infecção do sítio cirúrgico em um hospital público de Belo Horizonte-MG. 2011. Dissertação (Mestrado em Enfermagem) - Escola de Enfermagem - Universidade de São Paulo, São Paulo, 2011.
12. Sasaki VDM, Romanzini AE, Jesus APM, Carvalho E, Gomes JJ, Damiano VB. Surgical site infection surveillance in post-hospital discharge after cardiac reconstructive surgery. Texto contexto - enferm 2011; 20:328-332.
13. Oliveira AC, Ciosak SI, D' Lorenzo. Post-discharge surveillance and ITS impact ON surgical site infection incidence. Rev Esc Enferm USP, São Paulo 2007; 41:653-659.
14. Ercole FF, Chianca TCM, Duarte DS Carlos EF, Carneiro M. Surgical site infection in patients submitted to orthopedic surgery: the NNIS risk index and risk prediction. Rev Latino-Am Enfermagem 2011; 19:269-276.
15. Breigeiron R. Fatores de risco para infecção de sítio cirúrgico em pacientes submetidos à cirurgia por perfuração esofágica. Porto Alegre: PUCRS. Dissertação (Mestrado) - Pontifícia Universidade Católica do Rio Grande do Sul. Faculdade de Medicina, 2005.
16. Felippe WAB. Fatores associados à infecção do sítio cirúrgico após cirurgia para o tratamento do câncer de mama em mulheres usuárias do sistema de drenagem. [Masters Dissertation]. [Rio de Janeiro]: Universidade Federal do Rio de Janeiro; 2005.
17. Parker WH, Broder MS, Chang E, Feskanich D, Farquhar C, Liu Z, et al. Ovarian conservation at the time of hysterectomy and long-term health outcomes in the nurses' health study. Obstet Gynecol 2009; 113: 1027-1037.
18. Sória HLZ, Fagundes DJ, Sória-Vieira S, Cavalli N, Santos, CRC. Hysterectomy and benign gynecological diseases: what has been performed in Medical Residency in Brazil? Rev Bras Ginecol Obstet 2007; 29:67-73.
19. Batista TF, Rodrigues MCS. Surveillance of surgical site infection after hospital discharge in a teaching hospital of the Federal District, Brazil: a retrospective descriptive study in the period 2005. Epidemiol Serv Saude 2012; 21:253-264.
20. Lake AMG, McPencow AM, Dick-Biascoechea MA, Martin DK, Erekson EA. Surgical site infection after hysterectomy. Am J Obstet Gynecol 2013; 209:490-499.
21. Costa AAR, Amorim MMR, Cursino T. Vaginal hysterectomy versus abdominal hysterectomy in patients without uterine prolapse: a randomized clinical trial. Rev Bras Ginecol Obstet 2003; 25:169-176.
22. Geller EJ**.** Vaginal hysterectomy: the original minimally invasive surgery. Minerva Ginecol 2014; 66:23-33.
23. Custovic A, Zulcic-Nakic V, Asceric M, Hadzic S. Surveillance of intrahospital infections at the clinic for gynaecology and obstetrics. Bosn J Basic Med Sci 2009; 9:66-70.
24. Moraes CM, Galvão CM. Surgical site infection: analysis of scientific production in nursing. Rev SOBECC 2006; 11:22-31.
25. Silva ECBF, Samico TM, Cardoso RR, Rabelo MA, Bezerra NAM, Melo FL, et al . Colonization by *Staphylococcus aureus* among the nursing staff of a teaching hospital in Pernambuco. Rev Esc Enferm USP 2012; 46:132-137.
26. Aguiar APL, Prado PR, Opitz SP, Vasconcelos SP, Faro ARMC. Factors associated with surgical site infections in a hospital in the western brazilian amazon. Rev SOBECC 2012; 17:60-70.
27. Ledur P, Almeida L, Pellanda LC, D'Agord Schaan B. Predictors of infection in post-coronary artery bypass graft surgery. Rev Bras Cir Cardiovasc 2011; 26:190-196.
28. Chen S, Anderson MV, Cheng WK, Wongworawat MD. Diabetes associated whith increased surgical site infection in spinal arthrodesis. Orthop Relat Res Clin 2009; 467:1670-1673.
29. Gutiérrez MGR, Gabrielloni MC, Barbi T, Areias VL. Surgical site infections: surveillance measures in the early discharge after breast cancer surgery. Rev Bras Cancer 2004; 50:17-25.