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RESEARCH ARTICLE

Bacteriological Profile and Antibiotic Sensitivity Pattern of Surgical Site Infection Following Gynecologic Oncology Surgery at Hasan Sadikin General Hospital

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Abstract

Introduction*: Surgical site infection (SSI) is the most common complication of gynecologic oncology surgeries. Understanding the characteristics, bacteriological profile, and antibiotic sensitivity pattern of SSI patients can help guide patient's management and reduce morbidity, mortality, and economic burden caused by SSI. The aim of this study is to describe the characteristics, bacteriological profile, and antibiotic sensitivity pattern of SSI patients following gynecologic oncology surgery at Hasan Sadikin General Hospital Bandung in 2021.* ***Methods****: This is a descriptive study that analyzed medical records of patients undergoing gynecologic oncology surgery at Hasan Sadikin Hospital Bandung from January to December 2021.* ***Results****: Out of 157 gynecologic oncology surgeries in 2021 that met the criteria, there were 11 incidences of SSI (7%). All SSI patients received postoperative antibiotics, with the most common type of antibiotic given being a combination of ceftriaxone and metronidazole. Ten out of the 11 specimens from SSI patients showed bacterial growth and a total of 17 bacterial isolates were found. Most specimens showed polymicrobial infection with the most common isolate being Escherichia coli Extended-Spectrum Beta-Lactamase (ESBL). Gram-positive bacteria in this study were most sensitive to Vancomycin, Tigecycline, and Gentamicin. Meanwhile, gram-negative bacteria were most sensitive to Ertapenem and Meropenem.* ***Conclusion****: Incidence of SSI following gynecologic oncology surgery at Hasan Sadikin General Hospital in 2021 is 7%. The most frequently found isolate was Escherichia coli ESBL. Gram-positive bacteria were most sensitive Vancomycin, Tigecycline, and Gentamicin; while gram-negative bacteria were most sensitive to Ertapenem and Meropenem.*

Keywords: *bacteriological profile; antibiotic sensitivity; surgical site infection; gynecologic oncology*

INTRODUCTION

Surgical site infection (SSI) is defined as infection at surgical site that occurred within 30 days following surgical intervention. According to the World Health Organization (WHO), SSI is the most common type of nosocomial infection in low- and middle-income countries with an incidence of 11.8 episodes per 100 surgical procedures.[1] Center for Disease Control (CDC) reported that in the United States, hysterectomy performed for gynecologic abnormalities have a SSI rate of 1.7%.[2]

Surgical site infection is one of the most common complications following gynecologic oncology surgeries with its incidences varying between 5-35% and it remains as a significant cause of morbidity and mortality.[3,4] Gynecologic cancer is cancer originating from female reproductive system, namely cervix, ovaries, uterus, vagina, vulva, and fallopian tubes.[5] Surgery is the main therapeutic approach in most gynecologic cancer patients.[6] Most gynecologic oncology surgeries are radical and extensive, therefore causing higher risk of postoperative complications including SSI. Gynecologic oncology surgeries are also usually longer in duration than benign gynecologic surgery.[7] In addition, patients with malignancy often have various immunological disorders that also contribute to higher risk of developing SSI.[3,8]

Surgical site infection occurs when surgical wound contamination defeats host's immune system. Organisms that cause SSI can originate either from endogenous environment (from the patient's skin or organs), exogenous (surgical instruments, operating theaters, etc.), or from distant sources of infection that spread hematogenously and attach to prosthesis or other implant during surgery. Control measures against common organisms causing SSI can help reduce its incidence. Several bacteriological studies have shown that SSI is very universal and causative agent varies depending on geographic location, hospital, and type of surgical procedure performed.[9–12] Antibiotic sensitivity pattern of organisms causing SSI also vary globally depending on the region, local epidemiology, and methodologies of bacterial sensitivity testing. Irrational use of broad-spectrum antibiotics will exacerbate antimicrobial resistance. Bacterial resistance to antibiotics will complicate SSI therapy and increase patient morbidity and mortality.[9,10,13]

Surgical site infections can affect wound healing speed, prolong treatment, and increase treatment cost. Furthermore, severe infections can affect patient morbidity, mortality, and prognosis.[14] A review of SSI patients' characteristics, bacteriological profile, and antibiotic sensitivity patterns can assist in selecting a more appropriate empirical antimicrobial therapy and help reduce morbidity, mortality, and economic burden posed by SSI.[3,4] The aim of this study is to describe the characteristics, bacteriological profile, and antibiotic sensitivity pattern of SSI patients following gynecologic oncology surgery at Hasan Sadikin General Hospital Bandung in 2021.

METHODS

This is a descriptive study that analyzed medical records of patients undergoing gynecologic oncology surgery at Hasan Sadikin General Hospital Bandung from January - December 2021. Sampling was carried out using the total sampling method. Inclusion criteria were women who underwent surgery for gynecologic cancer confirmed by histopathological results. Meanwhile, the exclusion criteria included incomplete and inaccessible medical record data. Data processing and analysis were performed using Microsoft Excel/IBM SPSS Statistics.

RESULTS

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There were a total of 157 women who underwent gynecologic oncology surgery in the period January – December 2021 at Hasan Sadikin General Hospital Bandung. Of these 157 subjects, 11 had surgical site infections (7%). Mean age of SSI patients was 49.09±12.80 years. Most SSI patients (54.54%) had ovarian cancer, 27.27% had cervical cancer, 9.09% gestational trophoblastic tumor, and the remaining 9.09% had endometrial cancers. Majority of SSI patients (90.9%) underwent surgery with a duration of >3 hours. All SSI patients received postoperative antibiotics, 5 received a combination of ceftriaxone and metronidazole, 4 received single dose of ceftriaxone only, and the other 2 received a single dose of cefazolin antibiotic.

Table 1. Characteristics of the subjects

Variables	**n=11**
Age (years)	
Mean ± Std	49.09±12.80
Range (min-max)	19-65
Cancer type	
Ovarian cancer	6 (54.54%)
Cervical cancer	3 (27.27%)
Endometrial cancer	1 (9.09%)
Tumor Trofoblastik Gestasional	1 (9.09%)
Diagnosis	
Fascial dehiscence	9 (81.81%)
Burst abdomen	2 (18.18%)
Onset of SSI Diagnosis (postoperative day -)	
Mean ± Std	6.09±3.53
Pre-operative Risk Factors	
Anemia	7 (63.63%)
Leukocytosis	7 (63.63%)
Hypoalbuminemia	5 (45.45%)
Malnutrition	2 (18.18%)
Diabetes mellitus	1 (9.09%)
Lung disease	2 (18.18%)
Type of surgery	
Laparotomy biopsy	2 (18.18%)
Radical hysterectomy	2 (18.18%)
Hysterectomy and bilateral salpingo-oophorectomy	2 (18.18%)
Surgical staging	3 (27.27%)
Optimal debulking	2 (18.18%)
Surgery duration	
≤3 hours	1 (9.09%)
>3 hours	10 (90.90%)
Mean ± Std	259±102 menit
Postoperative antibiotic	
Ceftriaxone + Metronidazole	5 (45.45%)
Ceftriaxone	4 (36.36%)
Cefazolin	2 (18.18%)
Postoperative bleeding	
<1000 mL	0 (0%)
≥1000 mL	11 (100%)

We took specimens from all SSI patients and perform bacterial culture and antibiotic sensitivity testing. Of the total 11 specimens, 10 specimens showed bacterial growth and a total of 17 bacterial types were isolated. Four (23.53%) were gram-negative organisms and the remaining

13 (76.47%) were gram-positive isolates. Table 2 shows the bacteriological profile of SSI patients in this study. Seven specimens showed double microbial infection. Escherichia coli (29.41%) was the most common isolate. Four of the 5 Escherichia coli isolates were Extended-Spectrum Beta-Lactamase (ESBL).

Table 2. Bacterial isolates of patients with surgical site infections

Organisms		Frequency	Percentage
Gram positive (4/17)	*Staphylococcus aureus*	1	5.88
	Staphylococcus lugdunensis	1	5.88
	Enterococcus faecalis	1	5.88
	Enterococcus faecium	1	5.88
Gram negative (13/17)	*Escherichia coli*	5	29.41
	Citrobacter youngae	1	5.88
	Morganella moraganii	1	5.88
	Klebsiella pneumoniae	2	11.76
	Pseudomonas aeruginosa	2	11.76
	Acinetobacter baumanii	2	11.76
***Double microbial infection* (n=7)**	*E. coli* and *Pseudomonas aeruginosa*	2	28.57
	E. coli and *Klebsiella pneumoniae*	1	14.28
	Citrobacter youngae and *Morganella moraganii*	1	14.28
	Klebsiella pneumoniae and *Acinetobacter baumanii*	1	14.28
	Staphylococcus aureus and *Acinetobacter baumanii*	1	14.28
	Enterococcus faecalis and *Enterococcus faecium*	1	14.28

Gram-positive bacteria in this study were most sensitive to Vancomycin, Tigecycline, and Gentamicin; and most resistance to erythromycin (Table 3). Meanwhile, gram-negative bacteria were found to be most sensitive to Ertapenem and Meropenem (100%), followed by Gentamicin (84.6%), then Amikacin (76.9%); and most resistant to ampicillin (92.31%), followed by ceftriaxone and cefotaxime (61.54%) (Table 4).

Table 3. Antibiotic sensitivity pattern of gram (+) bacteria isolates in SSI patients

Antibiotics	Sensitive		Resistant		Total
	Frequency	Percentage	Frequency	Percentage	
Ampicillin/ sulbactam	3	75%	1	25%	4
Amoxicillin clavulanate	3	75%	1	25%	4
Erythromycin	2	50%	2	50%	4
Vancomycin	4	100%	0	0%	4
Cotrimoxazole	2	100%	0	0%	2
Ceftriaxone	2	100%	0	0%	2
Cefazolin	2	100%	0	0%	2
Cefotaxime	2	100%	0	0%	2
Ceftazidime	2	100%	0	0%	2
Cefepime	2	100%	0	0%	2
Cephalothin	2	100%	0	0%	2
Ciprofloxacin	3	75%	1	25%	4
Gentamicin	4	100%	0	0%	4
Tigecycline	4	100%	0	0%	4
Meropenem	2	100%	0	0%	2

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Ertapenem	2	100%	0	0%	2

Table 4. Antibiotic sensitivity pattern of gram (-) bacteria isolates in SSI patients

Antibiotics	Sensitive		Resistant	
	Frequency	Percentage	Frequency	Percentage
Ampicillin	1	7.69%	12	92.31%
Ampicillin/ sulbactam	8	61.54%	5	38.46%
Cotrimoxazole	6	46.15%	7	53.85%
Ceftriaxone	5	38.46%	8	61.54%
Cefazolin	9	69.23%	4	30.77%
Cefotaxime	5	38.46%	8	61.54%
Ceftazidime	9	69.23%	4	30.77%
Cefepime	9	69.23%	4	30.77%
Ciprofloxacin	8	61.54%	5	38.46%
Amikacin	11	84.62%	2	15.38%
Gentamicin	11	84.62%	2	15.38%
Tigecycline	12	92.31%	1	7.69%
Meropenem	13	100%	0	0%
Ertapenem	13	100%	0	0%
Aztreonam	6	46.15%	7	53.85%

DISCUSSION

Surgical site infection refers to infection in the surgical area occuring within 30 days after surgical intervention and can take place either superficially in the incision area, deeply in the incision area, or in other organs/spaces manipulated during the surgical procedure. Surgical site infections have a major impact on patient's morbidity and mortality, as well as affecting healthcare cost and burdens.[1] Incidence of SSI following gynecologic cancer surgery varies between 5-35%.[4] In this study, out of the 157 gynecologic oncology surgeries in 2021 that met the criteria, there were 11 incidences of SSI (7%). This result is similar to the study by Mahdi et al who also found that 7% of patients undergoing laparotomy for gynecologic cancer experienced SSI.[15]

All SSI patients in this study were diagnosed with abdominal wound dehiscence (either burst abdomen or fascial dehiscence), and on average, they were diagnosed at postoperative day 6.09±3.53. Wound dehiscence is the partial or total separation of previously approximated wound edges. This is caused by impaired wound healing and usually occurs in early phase of wound healing, which is 5-8 days following surgery.[16] Surgical site infection is one of the main causes of wound dehiscence.[17]

Surgical site infections are known to be associated with preoperative, operative, and postoperative risk factors. Preoperative factors that are associated mostly include host factors such as anemia, hypoalbuminemia, nutritional status, and comorbidities. A total of 63.63% of SSI patients in this study had preoperative anemia (Hb<12 mg/dL) and about 45.45% had hypoalbuminemia (albumin <3.5 g/dL). Anemia can affect healing process because haemoglobin plays an important role in the distribution of oxygen to regenerating tissues. Similarly, albumin also plays a key role in the healing process.[15] In our study, most subjects experienced >1000 mL postoperative bleeding and underwent surgery with a duration of >3 hours. Large amounts of bleeding and lengthy surgical procedures can increase the risk of postoperative infection. One previous study found that bleeding >500 mL and duration of surgery >140 minutes were associated with an increased risk of deep incisional and organ space SSI.[7] In this study two of the 11 SSI subjects were malnourished before undergoing surgery. A study by Klein et al found that preoperative malnutrition is one significant predictor for postoperative complications including infection.[18]

The most widely administered postoperative antibiotic to SSI patients in our study was the combination of ceftriaxone and metronidazole. This combination is commonly used as postoperative prophylaxis in Hasan Sadikin General Hospital. Ceftriaxone is a third-generation cephalosporin drug with a broad spectrum activity against gram positive and negative bacteria including Enterobacteriaceae. The bactericidal activity of ceftriaxone comes from its ability to inhibit bacterial cell wall synthesis. Ceftriaxone antibiotics have a fairly long half-life, which is around 8 hours. This drug is also stable to beta lactamase and has great tissue penetration ability.[19,20] Metronidazole, on the other hand, is one of the most commonly used drug to combat anaerobic and protozoal infections. Metronidazole exerts its antimicrobial effect through the production of free radicals. This antibiotic is often used as prophylactic drug for abdominal and gynecologic surgery to reduce risk of SSI caused by anaerobic bacteria. For prevention or treatment of mixed aerobic and anaerobic bacteria, metronidazole should be combined with other antimicrobial agents because metronidazole is not effective against aerobic bacteria.[21]

Organisms causing SSI can originate either from endogenous environment (from the patient's skin or organs), exogenous (surgical instruments, operating theaters, etc.), or from distant sources of infection that spread hematogenously and attach to prosthesis or other implant during surgery. Surgical site infections in general are most often caused by endogenous microorganisms on the patient's skin, which consist mostly of gram-positive bacteria, especially Staphylococcus aureus. However, the pathogen causing SSI will eventually depend on the site of the operation. In gynecologic surgeries, the causative pathogen can originate from skin, vagina, or endocervix. The endogenous vaginal flora consists of a complex mixture of gram-positive, gram-negative, and anaerobic bacteria. Therefore, SSI in gynecologic surgery is more often polymicrobial and caused by gram-negative bacilli, enterococci, group B streptococci, and anaerobic bacteria compared to SSI in general. In this study, most SSI (63.63%) were polymicrobial infections and the most common isolate found was Escherichia coli (29.41%). This result is in line with the previous literatures.[7,12,22]

Gram-positive bacteria in this study were most sensitive to the antibiotics Vancomycin, Tigecycline, and Gentamicin (100%). Meanwhile, gram-negative bacteria were found to be the most sensitive to Ertapenem and Meropenem (100%), followed by Gentamicin (84.6%), then Amikacin (76.9%). In this study, gram (+) bacteria were found to be most resistant to erythromycin, while gram (-) bacteria were predominantly resistant to ampicillin, followed by ceftriaxone and cefotaxime. We found 4 isolates of Escherichia coli ESBL which are enzymes produced by bacteria that can hydrolyze beta-lactam antibiotics with extended spectrum (including 3rd generation cephalosporins and aztreonam). Carbapenem antibiotics such as ertapenem and meropenem are the antibiotics of choice for organisms that produce ESBL.[23]

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CONCLUSION

Incidence of SSI following gynecologic oncology surgery at Hasan Sadikin General Hospital in 2021 is 7%. The most frequently found isolate was Escherichia coli ESBL. Gram-positive bacteria were most sensitive Vancomycin, Tigecycline, and Gentamicin; while gram-negative bacteria were most sensitive to Ertapenem and Meropenem.

REFERENCES

1. World Health Organization (WHO). Global Guidelines for the Prevention of Surgical Site Infection, second edition. World Health Organization. 2018. 1–186 p.
2. 2Pathak A, Mahadik K, Swami MB, Roy PK, Sharma M, Mahadik VK, et al. Incidence and risk factors for surgical site infections in obstetric and gynecological surgeries from a teaching hospital in rural India. Antimicrob Resist Infect Control. Antimicrobial Resistance & Infection Control; 2017;6(1):1–8.
3. Tuomi T, Pasanen A, Leminen A, Bützow R, Loukovaara M. Incidence of and risk factors for surgical site infections in women undergoing hysterectomy for endometrial carcinoma. Acta Obstet Gynecol Scand. 2016;95(4):480–5.
4. Inci A, Talmac M, lker V, Akbayir O, Numanoglu C. Risk Factors Influencing Development Of Surgical Site Infection In Patients Who Were Operated Due To Endometrial Cancer. Dis Mol Med. 2016;4(2):13.
5. Ledford LRC, Lockwood S. Scope and Epidemiology of Gynecologic Cancers: An Overview. Semin Oncol Nurs. Elsevier Inc.; 2019;35(2):147–50.
6. O'Donnell RL, Angelopoulos G, Beirne JP, Biliatis I, Bolton H, Bradbury M, et al. Impact of surgical site infection (SSI) following gynaecological cancer surgery in the UK: A trainee-led multicentre audit and service evaluation. BMJ Open. 2019;9(1):1–8.
7. Lachiewicz MP, Moulton LJ, Jaiyeoba O. Pelvic Surgical Site Infections in Gynecologic Surgery. Infect Dis Obstet Gynecol. 2015;2015:1–8.
8. Kadija S, Stefanović A, Jeremić K, Tavčar J, Argirović R, Pantović S. Malignant disease as a risk factor for surgical site infection. Clin Exp Obstet Gynecol. 2012;39(1):53–6.
9. Misha G, Chelkeba L, Melaku T. Bacterial profile and antimicrobial susceptibility patterns of isolates among patients diagnosed with surgical site infection at a tertiary teaching hospital in Ethiopia: a prospective cohort study. Ann Clin Microbiol Antimicrob. BioMed Central Ltd; 2021 Dec 1;20(1):1–10.
10. Chaudhary R, Thapa SK, Rana JC, Shah PK. Surgical Site Infections and Antimicrobial Resistance Pattern. JNHRC.
11. Njoku CO, Njoku AN. Microbiological Pattern of Surgical Site Infection Following Caesarean Section at the University of Calabar Teaching Hospital. Open Access Maced J Med Sci. Scientific Foundation SPIROSKI; 2019 May 15;7(9):1430.
12. Owens CD, Stoessel K. Surgical site infections: epidemiology, microbiology and prevention. J Hosp Infect. 2008;70(S2):3–10.
13. Negi V, Pal S, Juyal D, Sharma MK, Sharma N. Bacteriological Profile of Surgical Site Infections and Their Antibiogram: A Study From Resource Constrained Rural Setting of Uttarakhand State, India. J Clin Diagn Res. JCDR Research & Publications Private Limited; 2015 Oct 1;9(10):DC17.

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14. Shi L, Gu Q, Zhang F, Li D, Ye W, Zhong Y, et al. Predictive factors of surgical site infection after hysterectomy for endometrial carcinoma: a retrospective analysis. BMC Surg. BioMed Central; 2021;21(1):1–7.
15. Mahdi H, Gojayev A, Buechel M, Knight J, SanMarco J, Lockhart D, et al. Surgical Site Infection in Women Undergoing Surgery for Gynecologic Cancer. Int J Gynecol Cancer. 2014 May 1;24(4):779–86.
16. Ozimek A, Clavien PA, Nocito A. Wound Dehiscence. Total Implant Venous Access Devices Manag Mid- Long-Term Clin Setting. StatPearls Publishing; 2022 May 8;157–60.
17. Sandy-Hodgetts K, Carville K, Leslie GD. Determining risk factors for surgical wound dehiscence: a literature review. Int Wound J [Internet]. 2015 Jun;12(3):265–75. Available from: https://onlinelibrary.wiley.com/doi/10.1111/iwj.12088
18. Klein JD, Hey LA, Yu CS, Klein BB, Coufal FJ, Young EP, et al. Perioperative Nutrition and Postoperative Complications in Patients Undergoing Spinal Surgery. Spine (Phila Pa 1976). 1996 Nov;21(22):2676–82.
19. Scholar E. Ceftriaxone. xPharm Compr Pharmacol Ref. Elsevier Inc.; 2007;1–7.
20. Li X, Li H, Li S, Zhu F, Kim DJ, Xie H, et al. Ceftriaxone, an FDA-approved cephalosporin antibiotic, suppresses lung cancer growth by targeting Aurora B. Carcinogenesis. 2012 Dec;33(12):2548–57.
21. Löfmark S, Edlund C, Nord CE. Metronidazole Is Still the Drug of Choice for Treatment of Anaerobic Infections. Clin Infect Dis. 2010 Jan;50(s1):S16–23.
22. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for Prevention of Surgical Site Infection, 1999. Infect Control Hosp Epidemiol. 1999 Apr 2;20(4):247–80.
23. Paterson DL, Bonomo RA. Extended-Spectrum β-Lactamases: a Clinical Update. Clin Microbiol Rev. 2005 Oct;18(4):657–86.