Comparison of Postoperative Surgical Site Infections in Laparoscopic and Open Hysterectomy

Laparoskopik ve Açık Histerektomilerde Postoperatif Cerrahi Alan Enfeksiyonlarının Kıyaslanması

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Objectives: Hysterectomy is one of the most frequently performed surgical operations in gynecology clinics and is carried out through either laparoscopic or open surgery. Surgical site infections are among the significant and common complications in this procedure. Antibiotics are one of the most important factors in reducing the risk of surgical site infections after hysterectomy.

Materials and Methods: This study was conducted on patients who underwent laparoscopic and open hysterectomy due to benign pathologies. Both surgical methods were examined in terms of postoperative infectious complications and the antibiotic treatments applied retrospectively.

Results: The study was conducted on a total of 111 patients. Surgical site infection, surgery duration, rehospitalization, and oral antibiotic usage rates were found to be lower in patients who underwent laparoscopic surgery compared to open surgery. Infectious complication rates were detected at a higher rate in obese patients, diabetic patients, and patients with long surgery and hospital stay durations. ($p<0.05$)

Conclusions: Laparoscopic hysterectomy has significant advantages such as lower surgical site infections, and consequently, shorter hospital stays, lower nosocomial infection rates, reduce

Keywords: Laparoscopic hysterectomy; Open hysterectomy; Infection; Antibiotic therapy; Prophylaxis.

Amaç: Histerektomi jinekoloji kliniklerinde en sık yapılan ameliyatlardan birtanesi olup hem laparoskopik hem de açık yöntemle yapılmaktadır.Cerrahi alan enfeksiyonları bu ameliyatın sık ve önemli bir komplikasyonudur.Antibiyotikler histerektomi sonrası gelişen cerrahi alan enfeksiyon riskini azaltan en önemli faktördür.

Gereç ve Yöntem: Bu çalışma benign patolojiler nedeniyle laparoskopik ve açık histerektomi uygulanan hastalar üzerinde yapıldı.Her iki cerrahi metod postoperatif enfektif komplikasyonlar ve antibiyotik tedavileri yönünden retrospektif olarak incelendi.

Bulgular: Çalışma toplam 111 hasta üzerinde yapıldı.Laparoskopik cerrahi uygulanan hastalarda cerrahi alan enfeksiyonu, ameliyat süresi, rehospitalizasyon ve oral antibiyotik kullanım oranları açık cerrahi uygulanan hastalara göre daha düşük bulundu.Enfektif komplikasyon oranları obez hastalarda, diyabetik hastalarda, cerrahi süresi uzun olan hastalarda ve hastanede yatış süresi uzun olanlarda daha yüksek bulundu. ($p<0.05$)

Sonuç: Laparoskopik histerektominin; daha düşük cerrahi alan enfeksiyonları,daha kısa hospitalizasyon süresi, daha düşük nazokomiyal enfeksiyon oranları, daha düşük antibiyotik kullanımı ve daha düşük tedavi maliyetleri sağlaması gibi önemli avantajlara sahiptir.

Anahtar Kelimeler: Laparoskopik histerektomi, Açık histerektomi, Enfeksiyon, Antibiyotik tedavisi, Profilaksi

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INTRODUCTION

Hysterectomy is one of the most frequently performed surgical operations in gynecology clinics. Hysterectomy can be performed laparoscopically, abdominally, and vaginally. Particularly in the last 20 years, total laparoscopic hysterectomy (TLH) has been widely practiced and offers significant advantages such as shortening hospital stay duration, providing faster recovery, allowing patients to return to their daily lives more quickly, causing less blood loss, and having a lower risk of infectious complications and postoperative pain (Lake et al., 2013). Surgical site infections, as with all surgical interventions, are significant complications in hysterectomy surgeries. The commonly seen surgical site infections after hysterectomy include wound infection, urinary tract infection, vaginal cuff infection, pelvic infection, and postoperative fever (Byun et al., 2020). In TLH, the risk of surgical site infections is approximately between 1.1% and 2.7%, while this rate is higher in total abdominal hysterectomy (TAH), around 4% (Mahdi et al., 2014; Shockley et al., 2017). Moreover, in TAH, rates as high as 80% have been reported in the literature (Agarwal et al., 2023).

In the last two decades, the incidence of surgical site infections following hysterectomy has significantly declined, primarily due to the widespread use of prophylactic antibiotics rather than post-infective treatments (Morgan et al., 2016 While the exact reduction rate may vary, it has been reported that prophylactic antibiotic use can significantly lower the risk of postoperative surgical site infections in TAH, particularly in high-risk patient populations. Besides the individual's immune system status, the virulence of bacteria, the extent of tissue trauma during surgery, and the amount of fluid accumulation (such as hematoma and seroma) in the surgical area are important factors in the development of surgical site infections (Ayeleke et al., 2017). In both laparoscopic and abdominal hysterectomies, the most commonly recommended and used prophylactic antibiotic agent is cefazolin, a first-generation cephalosporin, administered as a single dose (Bratzler et al., 2013). Prophylaxis is generally recommended within 2 hours before surgery and should be repeated intraoperatively in cases where the procedure exceeds 3 hours or when estimated blood loss exceeds 1000 to 1500 mL. In addition, it is recommended that postoperative antibiotic therapy should be limited to no more than 24 hours in patients without high-risk conditions such as diabetes, obesity, or elevated ASA scores (Ayeleke et al., 2017). In this study, we aimed to compare the postoperative surgical site infections and the applied antibiotic treatments in patients who underwent TLH and TAH in our clinic.

MATERIALS AND METHODS

This retrospective study was conducted on patients who underwent hysterectomy at the Gynecology and Obstetrics Clinic of Alanya Training and Research Hospital between January 2021 and May 2024. The study was approved by the ethics committee of Alanya Training and Research Hospital. (21/08/2024-19-09)

Inclusion Criteria:

-Patients who underwent laparoscopic and open hysterectomy for benign pathologies.

-Exclusion Criteria:

-Patients under 18 and over 65 years of age,

-Patients who had used antibiotics within the last week before the surgery, those with a history of any infectious disease within the last month before the surgery,

-Patients who were not in the risk group for postoperative infection (such as those with a history of diabetes, high ASA score, obesity, or advanced age) and were prescribed intravenous antibiotics beyond 24 hours or oral antibiotics at discharge for therapeutic rather than prophylactic purposes,

- Patients receiving immunosuppressive therapy or diagnosed with cancer, or those on chronic steroid use,

-Patients who underwent hysterectomy for malignant disease or final postoperative pathology was reported as malignant

-Patients who underwent emergency hysterectomy,

-Patients with massive bleeding during surgery and/or those who received blood transfusion, -

-Patients who were hospitalized for more than 3 days postoperatively,

-Patients who had a catheter for more than 6 hours postoperatively.
All patient data were obtained from the hospital digital data system and recorded. The following data were recorded for each patient:
-Demographic datas such as;age, weight, diabetes, comorbid diseases, and smoking history, ASA score, smear results
- Surgical parameters included operation duration, drain usage, intraoperative or postoperative complications, antibiotic administration, and incidence of surgical site infections.
Patients were classified as either laparoscopic or open hysterectomy groups. For each, antibiotic regimens, duration, and use of oral antibiotics were documented. Postoperative complications, particularly surgical site infections, and related treatments were evaluated..

All hysterectomy procedures were performed by the same surgical team. In TLH cases, access was established via the Veress needle technique with the use of three trocars, and the Rumi II served as the uterine manipulator. The vaginal cuff was closed using interrupted Vicryl sutures. The TAH procedure was carried out using the standard open abdominal hysterectomy technique, as previously described in gynecologic surgical practice guidelines (Bratzler et al., 2013), and the vaginal cuff was closed continuously with Vicryl sutures. A Foley catheter was inserted in all patients and routinely removed six hours after the operation.

Statistical analysis and ethical aspects

Descriptive statistics were presented as mean, standard deviation, median, minimum, maximum, frequencies, and percentages. Normality of data distribution was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Independent samples t-test was applied for normally distributed variables, while the Mann-Whitney U test was used for non-normal distributions. Qualitative variables were analyzed using the chi-square test. All statistical analyses were conducted using SPSS version 27.0.

RESULTS

A total of 120 patients were included in the study. Two patients with malignant histopathology result, one patient with massive bleeding during surgery, four patients with a history of antibiotic use before surgery, one patient who underwent emergency hysterectomy post-cesarean, and one patient who converted from laparoscopic to open surgery were excluded. The study was conducted on a total of 111 patients, with 58 in the TLH group and 53 in the TAH group. The mean age of the patients was 50.2 in the TLH group and 48.5 in the TAH group. The demographic data of the patients are presented in Table 1 (Table 1). When comparing the TLH and TAH patient groups, no statistically significant differences were found in age, BMI, ASA score, diabetes and smoking history, length of hospital stay, IV antibiotic treatment, and the development of intra-abdominal abscess ($p>0.05$). However, the duration of surgery, rehospitalization, and the rate of oral antibiotic use were significantly higher in the TAH group compared to the TLH group ($p<0.05$). Wound site infection was observed in 1 patient (1.7%) in the TLH group, and in 10 patients (18.9%) in the TAH group, with the TAH group having a statistically significantly higher rate compared to the TLH group ($p<0.05$). Comparative findings of patients who underwent TLH and TAH are presented in Table 1.
When comparing patients who developed postoperative surgical site infections to those who did not, it was found that BMI, diabetes, surgery duration, length of hospital stay, rehospitalization, and the rate of oral antibiotic use were significantly higher in patients who developed infections compared to those who did not ($p<0.05$). Comparative findings of patients with and without postoperative surgical site infections are presented in Table 2.

Table 1. Comparison of Demographic and Clinical Characteristics between TAH and TLH Groups

Variable	TAH (n=53, 47.7%)	TLH (n=58, 52.3%)	p
Age (years)	48.5 ± 5.2	50.2 ± 7.8	0.458
BMI (kg/m²)	27.8 ± 4.6	28.3 ± 4.6	0.559
ASA Score I	1 (1.9%)	2 (3.4%)	0.496
ASA Score II	52 (98.1%)	54 (93.1%)	
ASA Score III	0 (0.0%)	2 (3.4%)	
Smoking (-)	40 (75.5%)	50 (86.2%)	0.149
Smoking (+)	13 (24.5%)	8 (13.8%)	
Diabetes Mellitus (-)	48 (90.6%)	52 (89.7%)	0.873
Diabetes Mellitus (+)	5 (9.4%)	6 (10.3%)	
Operation time (min)	98.2 ± 28.8	74.0 ± 22.0	***0.000****
Hospitalization (2 days)	45 (84.9%)	55 (94.8%)	0.081
Hospitalization (3 days)	8 (15.1%)	3 (5.2%)	
Postop i.v. antibiotic (1 day)	53 (100.0%)	56 (96.6%)	0.496
Postop i.v. antibiotic (2 days)	0 (0.0%)	2 (3.4%)	
Postop oral antibiotic (-)	14 (26.4%)	57 (98.3%)	***0.000****
Postop oral antibiotic (5 days)	39 (73.6%)	1 (1.7%)	
Surgical site infection (-)	43 (81.1%)	57 (98.3%)	***0.003****
Surgical site infection (+)	10 (18.9%)	1 (1.7%)	
Postop intraabdominal abscess (-)	51 (96.2%)	58 (100.0%)	0.226
Postop intraabdominal abscess (+)	2 (3.8%)	0 (0.0%)	
Rehospitalization (-)	47 (88.7%)	58 (100.0%)	***0.008****
Rehospitalization (+)	6 (11.3%)	0 (0.0%)	

m: Mann–Whitney U test; X^2: Chi-square test; BMI: Body mass index *:p<0.05

Table 2. Comparison of patients who developed and did not develop postoperative infective complications in patients who underwent TLH and TAH

		SSI(+) n:11 (9.9%)		SSI (-)n:100 (91.1%)		
		Mean.±ss/n-%	Median	Mean.±ss/n-%	Median	P value
Operation	TAH	10 (90.9%)		43 (43.0%)		***0.003****
	TLH	1 (9.1%)		57 (57.0%)		
Age		50.27+7.96	46.00	49.32+6.6	48.00	0.909
BMI		32.6+3.7	33.30	27.6+4.4	27.73	***0.000****
ASA Score	I	0		3 (3.0%)		0.750
	II	11 (100%)		95 (95.0%)		
	III	0		2 (2.0%)		
Smoking	(+)	4 (36.4%)		17 (17.0%)		0.120
	(-)	7 (65.6%)		83 (83.0%)		
Diabetes Mellitus	(+)	4 (36.4%)		7 (7.0%)		***0.002****²
	(-)	7 (65.6%)		93 (93.0%)		
Operation Time (min)		130+23.6	130.0	80.7+24.0	85.0	***0.000****
Hospitilization(day)	2	7 (63.6%)		93 (93.0%)		***0.002****
	3	4 (36.4%)		7 (7.0%)		
Postoperative i.v. antibiotic	1	11 (100.0%)		98 (98.0%)		0.636
	2	0		2 (2.0%)		
Postoperative oral antibiotic	(-)	3 (27.3%)		68 (68.0%)		***0.008****
	5 days	8 (72.7%)		32 (32.0%)		
Rehospitilization	(+)	7 (63.6%)		0		***0.000****
	(-)	4 (36.4%)		100 (100.0%)		

SSI: surgical site infection, BMI: Body mass index, *:p<0.05

DISCUSSION

Reducing the risk of surgical site infections (SSIs) is a primary goal for all surgical procedures. Post-hysterectomy SSIs have the disadvantages of necessitating rehospitalization and leading to financial burdens. Despite various strategies such as altering antibiotic types and timing of administration, surgical site infections have not been completely eliminated. Their incidence remains higher than expected. (Cataife et al., 2014) Numerous studies have attempted to reduce SSIs through prophylaxis protocols or combination antibiotic regimens. However, overuse of antibiotics carries risks such as resistance, adverse reactions, higher costs, and disruption of normal flora. These include the development of bacterial resistance, side effects due to antibiotics, increased costs, and negative changes in the normal flora. (Bratzler et al., 2013; Cataife et al., 2014)

While prophylaxis and antibiotic treatment are crucial in the development of SSIs post-hysterectomy, many risk factors are also known to be significant in the development of these infections. One of the most important factors increasing the risk of SSIs after hysterectomy is the surgery being performed in the genital tract, which contains various and dense microorganisms. Additionally, the use of a Foley catheter postoperatively is a risk factor for genitourinary tract infections. (Ayeleke et al., 2017) Post-hysterectomy SSIs can include wound infections as well as vaginal cuff infections, urinary tract and bladder infections, pelvic floor infections, pelvic abscesses, infected pelvic hematomas, septicemia, and pneumonia. (Gershensen et al., 2001) In developing SSIs, both aerobic and anaerobic gram-positive and gram-negative bacteria are typically isolated, similar to the flora of the urethra and vagina. (Ayeleke et al., 2017) In our study, one patient in the TLH group developed a superficial wound infection. In the TAH group, three patients experienced superficial wound infections and were managed with outpatient oral antibiotics. Additionally, one patient developed an infection involving the subcutaneous tissue, another had a subcutaneous abscess, and one developed a vaginal cuff abscess. These three patients required rehospitalization and received intravenous antibiotics. Surgical intervention was necessary in two cases: one underwent wound debridement and secondary suturing, while the other had ultrasound-guided drainage. The cuff abscess was managed by transvaginal drainage. Besides the inherent microbial risk of operating in the genitourinary tract, additional factors have been associated with an increased likelihood of SSIs after hysterectomy. These include diabetes mellitus, obesity, smoking, prolonged hospital stay, extended surgical duration, use of immunosuppressive or steroid medications, and advanced age. (Lachiewicz et al., 2015) It has been reported that maintaining blood glucose levels below 140 mg/dL in the pre- and postoperative periods is significant in reducing postoperative infective complications. (King et al., 2011) It is also known that prolonged hospital stays increase the risk of nosocomial infections. Multiple studies confirm that prolonged operative time, obesity, and advanced age are independent risk factors for postoperative surgical site infections. (Agarwal et al., 2023; Matthews et al., 2014) In our study, it was found that obesity, diabetes, prolonged surgical) duration, and length of hospital stay were statistically significantly higher in patients who developed SSIs postoperatively compared to those who did not, and these factors were identified as important risk factors for the development of postoperative infections.

Hysterectomy surgeries employ various approaches and recommended antibiotic protocols for prophylaxis and postoperative antibiotic treatment. The use of prophylactic antibiotics is universally recommended for abdominal, laparoscopic, and vaginal hysterectomy procedures to reduce postoperative infectious complications. It is advised that prophylaxis be administered 15 to 60 minutes before the surgery, with additional doses recommended if the surgery exceeds three hours or if intraoperative blood loss exceeds 1500 ml. (Eyk et al., 2012) The most common practice in prophylaxis is a single dose of antibiotics, with first or second-generation cephalosporins and amoxicillin-clavulanic acid being the most recommended. Although some centers use broad-spectrum or combination antibiotics—including antiprotozoal agents—

against Gram-negative and anaerobic organisms, such practices are discouraged due to the potential for antibiotic resistance. (Ayeleke et al., 2017) A study comparing single antibiotic use to combined antibiotic use in hysterectomy patients found no difference between the groups regarding the development of surgical site infections. (Branch-Elliman et al., 2018) In our study, all patients received first-generation cephalosporin (cefazolin) prophylactically, and those who received postoperative intravenous antibiotic therapy for more than 24 hours or oral antibiotics upon discharge were excluded.

Hysterectomy surgeries employ various approaches and antibiotic protocols, which can be either prophylactic or anti-infective depending on the patient's condition and surgery type.

Numerous studies have reported that the risk of surgical site infections is lower with laparoscopic hysterectomy compared to open hysterectomy. One study reported that surgical site infections occurred in 17.6% of patients who underwent LH, while the rate was markedly higher at 82.4% among those who had TAH. (Agarwal et al., 2023) Another study comparing LH and TAH reported a 4% infection rate for LH and a 35% rate for TAH, indicating that the risk of infective complications is 6.5 times lower in laparoscopic surgery compared to open surgery. (Alkaaki et al., 2019) Another study attributed lower surgical site infection rates in laparoscopic hysterectomy to shorter operative times. (Pop-Vicas et al., 2017) A comparison of laparoscopic supracervical hysterectomy, TLH, laparoscopic-assisted vaginal hysterectomy, and total vaginal hysterectomy reported the lowest rates of superficial (0,6%) and deep (0,5%) surgical site infections in TLH. (Lake et al., 2013) In our study, the wound infection rate was 1.7% in the TLH group and 18.9% in the TAH group, with a statistically significant lower infection rate in laparoscopic surgery. The significantly lower rehospitalization rates due to infection in the laparoscopic surgery group suggest that laparoscopic surgery has a cost advantage over open surgery. Additionally, the higher use of oral antibiotics in the TAH group compared to the TLH group indicates that laparoscopic surgeries require less antibiotic use, which is another significant advantage. Moreover, our study demonstrated shorter operative durations in laparoscopic procedures, which may reduce complications related to prolonged surgeries, such as increased infection risk, greater blood loss, and extended anesthesia exposure.

Limitations

This study has some limitations. First of all, the study was planned retrospectively and was conducted on a small population. Prospective studies with larger patient groups will provide stronger scientific evidence for the comparison of laparoscopic and laparotomy hysterectomies in terms of wound infections and the other infectious complications.

CONCLUSION

It is well known that laparoscopic surgery has many advantages over open surgery. In our study comparing laparoscopic and open hysterectomy in terms of postoperative surgical site infections, we found that obesity, diabetes, prolonged surgery duration, and extended hospital stays are significant risk factors for infectious complications. Furthermore, our study demonstrated that laparoscopic hysterectomy is associated with shorter surgery duration and lower rates of postoperative infectious complications. This results in significant advantages such as reduced postoperative antibiotic use and shorter hospital stays. Consequently, these benefits lead to a lower risk of antibiotic resistance, reduced incidence of nosocomial infections, and notably lower patient treatment costs, establishing laparoscopic surgery as the preferred method.

These findings suggest that the widespread adoption of laparoscopic hysterectomy in clinical practice could play a crucial role in reducing surgical site infections.

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The study was conducted in line with the principles of the "Helsinki Declaration."

Availability of Data and Materials: The datasets from the current study can be obtained on request from the corresponding author.

REFERENCES

Agarwal, M., Sinha, S., Haripriya, H., Kokkayil, P., & Singh, S.(2023). Surgical Site Infection in Laparoscopic Hysterectomy versus Abdominal Hysterectomy in Gynecological Disease(s): An Overview. *Gynecol Minim Invasive Ther*, 13(1): 25-29.

Alkaaki, A., Al-Radi, O.O., Khoja, A., Alnawawi, A., Alnawawi, A., Maghrabi, A., Altaf, A., & Aljiffry, M.(2019). Surgical site infection following abdominal surgery:A prospective cohort study. *Can J Surg*, 62: 111-7.

Ayeleke, R.O., Mourad, S.M., Marjoribanks, J., Calis, K.A., & Jordan, V.(2017).Antibiotic prophylaxis for elective hysterectomy. *Cochrane Database of Systematic Reviews*, 6;CD004637.

Balcı, O.(2014). Comparison of total laparoscopic hysterectomy and abdominal hysterectomy. *Turk J Obstet Gynecol*, 11: 224-7.

Branch-Elliman, W., Ripollone, J., O'Brien, W., Itani, K., Strymish, J., & Gupta, K.(2018). Combination Antimicrobial Prophylaxis for Hysterectomy: Harm without the Benefit? *Am J Obstet Gynecol*, 218(5): 536-537.

Bratzler, D.W., Dellinger, E.P., Olsen, K.M., Perl, T.M., Auwaerter, P.G., Bolon, M.K., Fish, D.N., Napolitano, L.M., Sawyer, R.G., Slain, D., Steinberg, J.P., & Weinstein, R.A. (2013). Clinical practice guidelines for antimicrobial prophylaxis in surgery. *Surg Infect*, 14: 73e156.

Byun, J.M., & Jeong, D.H. (2020). Antibiotic prophylaxis for gynecologic cancer surgery. *Taiwanese Journal of Obstetrics & Gynecology*, 59: 514-519.

Cataife, G., Weinberg, D.A., Wong, H.H., & Kahn, K.L. (2014). The effect of Surgical Care Improvement Project (SCIP) compliance on surgical site infections (SSI). *Med Care*, 52: S66-73.

Eyk, N.V., & Schalkwyk, J.V. (2012). Infectious Diseases Comittee, Antibiotic prophylaxis in gynaecologic procedures. *J Obstet Gynaecol Can* , 34(4): 382-391.

Fagotti, A., Costantini, B., Fanfani, F., Vizzielli, G., Rossitto, C., Lecca, A., & Giovanni Scambia. (2010). Risk of postoperative pelvic abscess in major gynecologic oncology surgery: one-year single-institution experience. *Ann Surg Oncol*, 17: 2452–2458.

Gershensen, C.M., DeCheney, A.H., Curry, S.L., & Brubaker, L. (2001). Postoperative infections. In Operative Gynecology. *WB Saunders*, 2: 123-31.

King, J.T., Goulet, J.L., Perkal, M.F., & Rosenthal, R.A..(2011). Glycemic control and infections in patient with diabetes undergoing non cardiac sur-gery. *Ann Surg*, 253: 158–165.

Lachiewicz, M.P., Moulton, L.J., & Jaiyeoba, O. (2015). Infection Prevention and Evaluation of Fever After Laparoscopic Hysterectomy. *JSLS*, 19 (3): e.00065

Lake, A.G., McPencow, A.M., Dick-Biascoechea, M.A., Martin, D.K., & Erekson, E.A. (2013). Surgical site infection after hysterectomy. *Am J Obstet Gynecol*, 209(5): 490.e1-490.e9

Li, M., Han, Y., & Feng, Y.C. (2012). Single-port laparoscopic hysterec-tomy versus conventional laparoscopic hysterectomy: a prospective randomized trial. *J Int Med Res*, 40: 701–708.

Mahdi, H., Goodrich, S., Lockhart, D., Debernardo, R., & Kebria, M.M. (2014). Predictors of surgicalsite infection in women undergoing hysterectomy for benigngynecologic disease: a multicenter analysis using the National Surgical Quality Improvement Program data. *J Minim Invasive Gynecol*, 21: 901–909.

Matthews, K.J., Brock, E., Cohen, S.A., & Chelmow, D.(2014). Hysterectomy in obese patients: special considerations. *Clin Obstet Gynecol*, 57(1): 106-14.

Morgan, D.M., Swenson, C.W., Streifel, K.M., Kamdar, N.S., Uppal, S., Burgunder-Zdravkovski, L., Pearlman, M.D., Fenner, D.E., & Campbell, D.A. (2016). Surgical site infection following hysterectomy: adjusted rankings in a regional collaborative. *Am J Obstet Gynecol*; 214: 259.e1-8.

Pop-Vicas, A., Musuuza, J.S., Schmitz, M., Al-Niaimi, A., & Safdar, N.(2017). Incidence and

risk factors for surgical site infection post-hysterectomy in a tertiary care center. *Am J Infect Control*, 45(3): 284-287.

Shockley, M.E., Beran, B., Nutting, H., Arnolds, K., Sprague, M.L., & Zimberg, S. (2017). The Sterility of Selected Operative Sites During Total Laparoscopic Hysterectomy. *The Journal of Minimally Invasive Gynecology*, 24(6):990-997