Developments and Experiments in Health and Medicine
Year: 2025
Volume: 39
Issue: 4
RESEARCH ARTICLE
Pages:265-278

Wound infections after abdominal surgery for gynecological cancer

Abdominal jinekolojik malignite cerrahileri sonrası yara enfeksiyonları

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Wound Infections after Abdominal Surgery for Gynecological Cancer
Received: 21.01.2025
Accepted: 13.06.2025
Doi:

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BACKGROUND
The objective of the present study was to ascertain the incidence of post-laparotomy wound infection and the principal risk factors associated with it. The study focused on a group of patients who had undergone gynaecological cancer surgery.
METHODS
In this retrospective cohort study, the data of 264 patients who underwent surgical procedures for gynaecological cancer between 15/10/2023 and 15/10/2024 in the Gynaecological Oncology Clinic of Izmir City Hospital were analysed. The demographic, operative, and clinical characteristics of patients with and without wound infection were compared.
RESULTS
The infection rate of the surgical wound was found to be 11.4% in the patient population who underwent laparotomy for gynaecological malignancy. The risk of wound infection was found to be approximately 14 times higher in patients receiving neoadjuvant chemotherapy (OR = 13.719; $p < 0.001$) and 6 times higher in patients requiring transfusion (OR = 6.282; $p = 0.004$). Furthermore, the probability of infection was found to increase with each 1 cm increase in incision length and depth (length OR = 1.196; $p = 0.021$; depth OR = 1.516; $p = 0.005$).
CONCLUSION
The most significant factors associated with the development of wound infection were identified as neoadjuvant chemotherapy and transfusion requirement. The main finding of our study was that incision depth and length were considered as risk factors for wound site infections following abdominal gynaecological malignancy surgeries.

KEYWORDS
Cancer surgery, incision length, laparotomy, neoadjuvant chemotherapy, wound complication

ÖZ

AMAÇ
Bu çalışmada, jinekolojik kanser cerrahisi geçirmiş hasta grubuna odaklanılarak, laparatomi sonrası gelişen yara enfeksiyonu komplikasyonunun insidansının ve ilişkili temel risk faktörlerinin belirlenmesi amaçlanmıştır.
GEREÇ YÖNTEM
Bu retrospektif kohort çalışma, İzmir Şehir Hastanesi Jinekolojik Onkoloji Kliniği'nde, 15.10.2023–15.10.2024 tarihleri arasında jinekolojik kanser nedeniyle cerrahi işlem uygulanan 264 hastanın verileri incelenerek gerçekleştirilmiştir. Yara enfeksiyonu gelişen ve gelişmeyen hastaların demografik, operasyonel ve klinik özellikleri karşılaştırılmıştır.
BULGULAR
Jinekolojik malignite endikasyonu ile laparatomi uygulanan hasta grubunda yara enfeksiyonu gelişme oranı %11,4 olarak saptanmıştır. Neoadjuvan kemoterapi alan hastalarda yara enfeksiyonu gelişme riski yaklaşık 14 kat artmış olarak bulunmuştur (OR = 13,719; $p < 0,001$). Transfüzyon ihtiyacı olan hastalarda ise bu risk 6 kat artmıştır (OR = 6,282; $p = 0,004$). Ayrıca, insizyon uzunluğu ve derinliğindeki her 1 cm'lik artışın, enfeksiyon gelişme olasılığını anlamlı şekilde artırdığı görülmüştür (Uzunluk: OR = 1,196; $p = 0,021$; Derinlik: OR = 1,516; $p = 0,005$).
SONUÇ
Yara enfeksiyonu gelişimini öngören en önemli faktörler neoadjuvan kemoterapi ve transfüzyon ihtiyacı olarak belirlenmiştir. Çalışmamızın temel bulgusu, insizyon derinliği ve uzunluğunun, abdominal jinekolojik malignite cerrahileri sonrasında yara yeri enfeksiyonu açısından anlamlı risk faktörleri olarak değerlendirilmesidir.

ANAHTAR KELİMELER
İnsizyon uzunluğu, kanser cerrahisi, laparotomi, neoadjuvan kemoterapi, yara komplikasyonu

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Surgical interventions remain the mainstay of treatment in gynecologic oncology. Despite the increasing utilisation of minimally invasive techniques, a significant proportion of patients still undergo abdominal laparotomic surgical procedures. Surgical site infections are defined as infections that develop within 30 days following surgery, or within one year if an implant has been placed and the infection is deemed to be surgically related (1). A superficial incisional infection (wound infection) develops only in the skin or subcutaneous tissue of the incision. The diagnosis of such an infection is made based on the presence of purulent drainage from the incision, in the absence or presence of laboratory diagnosis, growth in fluid or tissue culture obtained from the incision, or the presence of signs of infection (pain, tenderness, swelling, redness, warmth) in the area (2).

Wound infections represent a significant problem that has the potential to increase postoperative patient morbidity. They are associated with prolonged hospitalisation, the necessity for repeat operations, and increased healthcare costs. Furthermore, these infections can result in delays in the commencement of postoperative adjuvant therapy for patients with malignancy.

Wound infections are particularly prevalent in abdominal surgery, with several prospective studies demonstrating an incidence of 15-25% following such procedures (3,4). Several risk factors have been identified as contributing to the occurrence of wound infections. These include age, obesity, malignancy, duration of operation, diabetes mellitus, preoperative anaemia, hypertension, malnutrition, and smoking.

Gynecologic malignancy surgeries are more prone to WI than gynecologic surgeries performed for benign indications. The development of WI in cancer patients is hypothesised to be facilitated by impaired immunity. Furthermore, the fact that malignancy surgeries cover a larger area and have a longer operation time compared to surgeries performed for benign reasons is also an effective factor in this situation. The incidence of wound infections following laparotomy for endometrial cancer ranges from 3.86% to 31.1% (5). A study by O'Donnell et al. found surgical site infection to be 15.9% in gynecologic oncology patients undergoing laparotomy (6). The aim of the present study was to determine the incidence of wound infections (WI) and identify significant risk factors in patients undergoing abdominal surgery for gynecological malignancies. We specifically focused on malignant cases rather than benign gynecological conditions due to the limited number of studies addressing WI in the context of oncologic gynecologic surgery. Moreover, wound infections in cancer patients may result in prolonged hospitalization and potentially delay the initiation of adjuvant therapies, which can negatively impact overall prognosis. Given the immunosuppressive nature of cancer and its treatments, along with the more extensive and complex surgical procedures typically required, patients with gynecologic malignancies may present a higher risk profile for postoperative infectious complications.

Materials and Methods

This retrospective cohort study was conducted to investigate the factors affecting the development of WI in patients who underwent surgical procedures for gynecologic cancer between 15/10/2023 and 15/10/2024 in the Gynecologic Oncology Clinic of Izmir City Hospital. The study was conducted according to the Declaration of Helsinki, and the data of our single-centre retrospective study were obtained from the archive of Izmir City Hospital. The present study was approved by the ethics committee of Izmir City Hospital (No: 2024/143 Date: 06/11/2024). The study evaluated the patients' demographic characteristics, clinical parameters, operative details, and 30-day postoperative wound complication data.

Patients who underwent laparoscopic surgery, those who had a pfannenstiel incision, patients who were operated for benign gynaecological reasons (myoma, endometriosis, benign ovarian cyst), patients who were referred to another clinic in the postoperative period for various reasons, patients who underwent hyperthermic intraperitoneal chemotherapy (HIPEC), patients with preoperative infection or acute infection due to another systemic disease, and patients with incomplete follow-up data were excluded from the study. Patients with ileostomy and colostomy were also excluded from the study in order to reduce variables. Due to the limited utilisation of the Pfannenstiel incision in gynaecological oncology surgery and to mitigate the variability in the study, patients who underwent the Pfannenstiel incision were excluded from the study. The data of 264 patients were

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analysed, and the demographic and clinical characteristics of patients with and without WI were compared.

All patients received standard preoperative clinical care. For venous thromboembolism prophylaxis, low molecular weight heparin (enoxaparin) was administered subcutaneously at a dose of 40 mg, 12 hours prior to surgery. For antibiotic prophylaxis, intravenous prophylactic cefazolin was administered 30 minutes before surgery, and clindamycin or metronidazole was used when penicillin was contraindicated. Single-dose antibiotic prophylaxis was administered intravenously with 2 g of cefazolin, and patients weighing more than 120 kg were administered 3 g of cefazolin

In surgeries lasting longer than three hours or with total blood loss of 1000 mL or more, additional doses of antibiotics were administered. Surgical procedures were performed by the same gynecologic oncology surgical team, and all patients in the study underwent surgery through a median incision. The length of the wound was measured from the lowest to the highest point of the incision using a sterile ruler, and the incision depth was recorded as the deepest point of the incision using the same instrument.

The data analysis was conducted using SPSS 29.0 (Statistical Package for Social Sciences) software. In the context of descriptive statistics, categorical variables were presented as number and percentage, while continuous variables were presented as mean ± standard deviation for normally distributed data and median (interquartile range) for non-normally distributed data. The Shapiro-Wilks test was employed to ascertain normal distribution.

The differences between the groups were evaluated using the chi-square test or Fisher's exact test for categorical variables and the student t-test or Mann-Whitney U test for continuous variables. Furthermore, the implementation of advanced logistic regression analysis was undertaken to ascertain the risk factors that influence the development of WI. For the analysis, $p < 0.05$ was accepted as the significance level. The results obtained are reported with odds ratios (OR) and 95% confidence intervals (CI).

The study employed Receiver Operating Characteristic (ROC) analysis to evaluate the diagnostic performance of the parameters utilised for predicting WI. Cut-off values were determined using the maximum K-S (Kolmogorov-Smirnov) ratio. The areas under the ROC curve (AUC) were subsequently calculated by non-parametric methods, and the diagnostic performance was interpreted based on sensitivity and specificity values. The analysis results are presented in graphs and tables with cut-off values.

Post-hoc power analysis for our logistic regression model was performed using G*Power 3.1 software to assess the adequacy of the sample size of our study. The analysis incorporated a clinically significant effect size of OR=6.3, a sample size of α=0.05, a sample size of 264, an estimated probability for the dependent variable ($Pr(Y=1|X=1)$) = 0.11, and an explanation ratio of other variables on the dependent variable (R2=0.67). The resulting power ($1-\beta$) was 0.999, showing that our study is statistically sufficient to detect such effects. The analysis was conducted using Demidenko's large sample z-test.

Results

An analysis of the demographic and clinical characteristics of patients who underwent surgical intervention for gynaecological cancer revealed that endometrial cancer was the predominant indication for surgery, accounting for 64.8% of cases. This was followed by ovarian cancer, which constituted 32.6% of cases, and cervical cancer, accounting for 2.7%. Approximately half of the patients (51.9%) had no history of previous surgical interventions, while the remaining 48.1% reported a history of surgery. Regarding the presence of comorbidities, 54.9% of patients were found to have no comorbidities, while 45.1% had comorbidities such as hypertension or diabetes, with the hypertension rate recorded as 25.4% and the diabetes rate as 25.8%. An analysis of skin closure methods revealed that wound closure with stapler was employed in 45.8% of cases, while primary suture method was used in 54.2%. Intraabdominal drains were used for 67.4% of patients, while this approach was not used for the remaining 32.6%. The most common duration of hospitalization was 4 to 6 days (58.7%), followed by 10 days or more for 4.9% of patients. The incidence of WI was found to be 11.4% (Table 1).

The mean age of the patients was 57.5 years (±12.3). The median BMI (body mass index) was 29.6, with 47.0% of patients classified as obese, 34.8% as overweight, and 17.4% as normal weight. The median operation time was 130 minutes

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(80-250 minutes), and the median anaesthesia time was 160 minutes (110-300 minutes). The length of hospitalisation ranged from 1 to 19 days, with a median duration of 4 days. The median incision length was 13 cm (8-24 cm), while the median incision depth was 7 cm (3-14 cm) (Table 2).

Table 1. Demographic and clinical characteristics of the patients

Variables	n (%)
Indication for surgery	
Endometrium cancer	171 (64.8)
Ovarian cancer	86 (32.6)
Cervical cancer	7 (2.7)
Wound Infection	
No	234 (88.6)
Yes	30 (11.4)
Incision	
Supraumbilical + subumbilical	125 (47.3)
Subumbilical	139 (52.7)
Intraabdominal drain	
No	86 (32.6)
Yes	178 (67.4)
Duration of hospitalization	
1–3 days	44 (16.7)
4–6 days	155 (58.7)
7–9 days	52 (19.7)
10 days or more	13 (4.9)
Neoadjuvant chemotherapy	
No	233 (88.3)
Yes	31 (11.7)
Ascites in the abdomen	
No	221 (83.7)
Yes	43 (16.3)
Ascites volume	
Over 500 cc	34 (79.1)
Under 500 cc	9 (20.9)
Transfusion need	
No	222 (84.1)
Yes	42 (15.9)
Transfusion time	
Preoperative	9 (20.5)
Intraoperative	11 (25.0)
Postoperative	24 (54.5)

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Additional analgesic need		
	No	205 (77.7)
	Yes	59 (22.3)
Operation history		
	No	137 (51.9)
	Yes	127 (48.1)
Additional disease		
	No	145 (54.9)
	Yes	119 (45.1)
Hypertension		
	No	197 (74.6)
	Yes	67 (25.4)
Diabetes		
	No	196 (74.2)
	Yes	68 (25.8)
Wound closure technique		
	Stapler	121 (45.8)
	Primary suture	143 (54.2)
Omentectomy		
	No	179 (67.8)
	Yes	85 (32.2)
Lymph node dissection		
	No	123 (46.6)
	Yes	141 (53.4)
Rehospitalisation		
	No	236 (89.4)
	Yes	28 (10.6)
Cigarette use		
	No	175 (66.3)
	Yes	89 (33.7)
BMI		
	Weak	2 (0.8)
	Normal	46 (17.4)
	Overweight	92 (34.8)
	Obese	124 (47.0)

BMI, body mass index

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Table 2. Duration based parameters and clinical measurements

Variables	Median	IQR	Min	Mak
Age*	57.5	12.3	21.0	87.0
Height	160.0	8.0	143.0	175.0
Weight	76.0	17.5	50.0	115.0
BMI	29.6	7.1	17.3	51.1
Hgb preoperative	12.6	1.3	8.4	15.9
Hgb postoperative	11.6	1.4	8.0	14.9
Hospitalization duration (days)	4.0	2.0	1.0	19.0
Operation time (min)	130.0	80.0	80.0	250.0
Duration of Anesthesia (Min)	160.0	80.0	110.0	300.0
Number of lns	12.0	15.0	0.0	49.0
Incision length	13.0	5.0	8.0	24.0
Incision depth	7.0	4.0	3.0	14.0

*Age and hemoglobin (Hgb) values were normally distributed, mean and standard deviation were given instead of median IQR. IQR, interquartile range; Min, minimum; Max, maximum; LN, lymph node; BMI, body mass index

When the clinical parameters associated with WI were evaluated in terms of incision type, the rate of patients developing WI was 16.7% in those who underwent subumbilical incision, and this rate increased to 83.3% in patients who underwent subumbilical and supraumbilical incisions ($p < 0.001$). Furthermore, the analysis revealed that 46.7% of patients who developed a WI infection received neoadjuvant chemotherapy, compared to 7.3% of patients who did not develop infection ($p < 0.001$). Furthermore, 53.3% of patients with infection required transfusion ($p < 0.001$). Furthermore, a history of surgical intervention was documented in 66.7% of patients who developed WI, while this proportion was significantly lower, at 33.3%, in those without a history of surgery ($p = 0.03$) (Table 3).

Table 3. The relationship between wound infection and clinical variables

Variables	Wound infection (+) n (%)	Wound infection (-) n (%)	p-value
Indication for surgery			
Endometrium cancer	17 (56.7)	154 (65.8)	
Ovarian cancer	12 (40.0)	74 (31.6)	0.614
Cervical cancer	1 (3.3)	6 (2.6)	
Incision type			
Supraumbilical + subumbilical	25 (83.3)	100 (42.7)	**<0.001**
Subumbilical	5 (16.7)	134 (57.3)	
Intraabdominal drain			
No	8 (26.7)	78 (33.3)	0.463
Yes	22 (73.3)	156 (66.7)	
Duration of hospitalization			
1–6 days	6 (20.0)	193 (82.5)	**<0.001**
≥7 days	24 (80.0)	41 (17.5)	
Neoadjuvant chemotherapy			
No	16 (53.3)	217 (92.7)	**<0.001**

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Yes	14 (46.7)	17 (7.3)	
Ascites			
No	15 (50.0)	206 (88.0)	**<0.001**
Yes	15 (50.0)	28 (12.0)	
Transfusion requirement			
No	15 (50.0)	207 (88.5)	**<0.001**
Yes	15 (50.0)	27 (11.5)	
Transfusion time			
Preoperative	1 (5.9)	8 (29.6)	
Intraoperative	5 (29.4)	6 (22.2)	0.125
Postoperative	11 (64.7)	13 (48.1)	
Additional analgesic need			
No	14 (46.7)	191 (81.6)	**<0.001**
Yes	16 (53.3)	43 (18.4)	
Operation history			
No	10 (33.3)	127 (54.3)	**0.031**
Yes	20 (66.7)	107 (45.7)	
Additional disease			
No	16 (53.3)	129 (55.1)	0.852
Yes	14 (46.7)	105 (44.9)	
Hypertension			
No	25 (83.3)	172 (73.5)	0.244
Yes	5 (16.7)	62 (26.5)	
Diabetes			
No	19 (63.3)	177 (75.6)	0.147
Yes	11 (36.7)	57 (24.4)	
Wound closure technique			
Stapler	13 (43.3)	108 (46.2)	0.770
Primary suture	17 (56.7)	126 (53.8)	
Omentectomy			
No	13 (43.3)	166 (70.9)	**0.002**
Yes	17 (56.7)	68 (29.1)	
Lymph node dissection			
No	9 (30.0)	114 (48.7)	0.053
Yes	21 (70.0)	120 (51.3)	
Rehospitalisation			
No	25 (83.3)	211 (90.2)	0.339
Yes	5 (16.7)	23 (9.8)	
Cigarette use			
No	19 (63.3)	156 (66.7)	0.716
Yes	11 (36.7)	78 (33.3)	

Chi-square test was used for univariate comparisons. Significant variables were included in the multivariate logistic regression.

The median length of hospitalisation was found to be significantly longer for patients who developed WI compared to those who did not ($p < 0.001$). Specifically, the median length of hospitalisation was 8 days in the WI group, while it was 4 days in the non-WI group. A similar trend was observed in the median operation time, which was found to be 180 minutes for patients who developed WI, as opposed to 120 minutes for those who did not ($p < 0.001$). The median duration of anaesthesia was found to be 197 minutes for patients who developed WI, compared with 155 minutes for those who did not ($p = 0.003$). In addition, the median incision length was

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found to be 18 cm for patients who developed WI, compared with 13 cm infor those who did not ($p < 0.001$). Similarly, the median incision depth was 9 cm in patients who developed WI, as opposed to 7 cm for those who did not ($p < 0.001$). (Table 4).

Table 4. Wound infection and duration-based parameters

Variables	Wound infection								
	Yes				No				p
	Median	IQR	Min	Max	Median	IQR	Min	Max	
Age*	59.3	11.0	35.0	77.0	57.2	12.5	21.0	87.0	0.393
Height	160.0	8.0	148.0	175.0	160.0	8.0	143.0	175.0	0.931
Weight	79.5	21.0	56.0	100.0	75.0	17.0	50.0	115.0	0.176
BMI	31.8	9.3	21.5	42.9	29.4	7.1	17.3	51.1	0.203
Hgb preoperative	12.8	1.4	9.2	14.8	12.6	1.3	8.4	15.9	0.331
Hgb postoperative	11.0	1.7	8.0	14.9	11.6	1.3	8.4	14.9	0.065
Operation time (min)	180.0	40.0	90.0	245.0	120.0	80.0	80.0	250.0	**<0.001**
Duration of anesthesia (min)	197.5	60.0	130.0	280.0	155.0	90.0	110.0	300.0	**0.003**
Number of lns	16.0	16.0	0.0	43.0	11.0	15.0	0	49.0	0.102
Incision length	18.0	5.0	10.0	24.0	13.0	4.0	8.0	24.0	**<0.001**
Incision depth	9.0	3.0	4.0	14.0	7.0	4.0	3.0	11.0	**<0.001**

Mann-Whitney U test was used. *Since age and hemoglobin (Hgb) values were normally distributed, Student's t-test was used and mean and standard deviation were given instead of median IQR. IQR, interquartile range; Min, minimum; Max, maximum; LN, lymph node; BMI, body mass index

The statistically significant and clinically important variables — incision length, incision depth, operation time, presence of ascites, transfusion, omentectomy, and neoadjuvant chemotherapy — were included in the forward logistic regression (LR Forward) model. The analysis revealed that the most significant model consisted of four variables: neoadjuvant chemotherapy, transfusion requirement, incision length, and incision depth. Patients who received neoadjuvant chemotherapy were approximately 14 times more likely to develop WI (OR = 13.719; $p < 0.001$). Similarly, patients who required transfusions were six times more likely to develop WI (OR = 6.282; $p = 0.004$). Furthermore, each 1 cm increase in incision length and depth was associated with a higher risk of infection (length OR = 1.196; $p = 0.021$; depth OR = 1.516; $p = 0.005$) (Table 5).

Table 5. Logistic regression results

Variables	Beta coefficient	Standard error	p	Odds ratio (OR)	OR 95% Confidence interval
Neoadjuvant chemotherapy	2.619	0.714	**<0.001**	13.719	(3.386 – 55.578)
Transfusion requirement	1.838	0.636	**0.004**	6.282	(1.806 – 21.848)
Incision length	0.179	0.077	**0.021**	1.196	(1.028 – 1.392)
Incision depth	0.416	0.148	**0.005**	1.516	(1.133 – 2.028)
Fixed	-11.404	2.043	<0.001		

Hosmer, Lemeshow Test: 0.819, Cox & Snell R Square: 0.340, Nagelkerke R Square: 0.671

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Table 6. ROC analysis results

Variables	AUC	95% CI AUC	P	Cut Value	Sensivity	Specificty
Incision length	0.77	(0.67-0.87)	**< 0.001**	15.5	73.3	77.8
Incision depth	0.70	(0.59-0.81)	**0.001**	8.5	60.0	71.4
Operation duration (min)	0.70	(0.61-0.79)	**< 0.001**	147.5	76.7	62.0

Although 11 variables were found to be statistically significant in the univariate analyses, only 7 of them were included in the multivariate logistic regression model, based on clinical relevance and inter-variable correlations. Among these, only 4 variables retained statistical significance and are presented in the final model table. The excluded variables neither contributed meaningfully to the model's performance nor explained variance. For example, the variable of hospital stay duration was intentionally excluded from the multivariate model, because prolonged hospitalization is more likely a consequence of wound infection rather than a predisposing factor. Including such outcome-related variables could introduce reverse causation bias and compromise the validity of the model. These results may also be influenced by inter-variable interactions and the limited sample size, both of which are common challenges in multivariate analysis. Although the confidence intervals for neoadjuvant chemotherapy and transfusion requirements were relatively wide, their associations remained statistically significant. This may reflect the strength of the observed effects but also highlights the impact that a limited number of events has on the precision of estimates.

The performance measures of the model were analysed, resulting in the calculation of sensitivity as 60% (95% CI: 42-76), specificity as 97% (95% CI: 95-99), positive predictive value as 75% (95% CI: 56-89) and negative predictive value as 95% (95% CI: 92-97). The overall accuracy of the model was determined to be 93%, and it was demonstrated that it possesses a robust discriminatory capability. According to the results of the ROC analysis, incision length exhibited the highest diagnostic performance in predicting the development of WI (AUC=0.77; $p < 0.001$). The cut-off value for incision length was determined to be 15.5 cm, with a sensitivity and specificity of 73.3% and 77.8%, respectively. The cut-off value for incision depth was established as 8.5 cm, with a sensitivity of 60.0% and specificity of 71.4% (AUC = 0.70; $p = 0.001$). The cut-off value for operation time was calculated as 147.5 minutes, with a sensitivity of 76.7% and a specificity of 62% (AUC=0.70; $p < 0.001$). The cut-off value for duration of anaesthesia was calculated as 152.5 minutes, with a sensitivity of 86.7% and a specificity of 45.3% (AUC = 0.67; $p < 0.001$) (Table 6).

These cut-off values are not only statistically significant but may also guide clinical decision-making. For example, recognizing that an incision length exceeding 15.5 cm or an operation longer than 147.5 minutes is associated with an elevated risk of wound infection can prompt earlier preventive measures, closer monitoring, or modified surgical planning. However, these thresholds should be interpreted cautiously in clinical applications and ideally validated in prospective studies.

Discussion

There is a lack of data exists in the literature regarding the incidence and outcomes of WI following laparotomic gynaecological oncology surgical procedures. Iyer et al. sought to ascertain the determinants of complications in women who had undergone surgery for gynaecological malignancy. The study identified grade II-to IV infections in 27.8% of all gynaecological surgery cases, accounting for 31% of all complications (7).

Surgical drains are frequently employed following gynaecological malignancy operations with a view to promoting healing by facilitating the drainage of body fluids from dead spaces, preventing lymphocele formation and preventing the development of WI. Despite the hypothesis that the use of drains in the postoperative period will lead to an increase in WI, studies in literature examining the relationship between routine postoperative drain use and WIs have revealed contradictory results (8). In our study, the presence of intra-abdominal drains was observed to be 73.3% for cases

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with infection and 66.7% for non-infected cases. While this difference was found to be statistically significant, further research in the form of randomised controlled studies is required to provide definitive clarification. The stapler is a reliable and efficient method for closing linear incisions. The existing literature on the subject has not demonstrated any significant difference in terms of WI when comparing the utilisation of primary suture with that of stapler in gynaecological surgery (9,10). In our study, no difference was observed between the two groups in terms of WI ($p = 0.463$).

Surgical site infection has been demonstrated to result in prolonged hospitalisation and delayed initiation of adjuvant therapy (chemotherapy ± radiotherapy) for patients undergoing surgical procedures for gynaecological cancer. Patients with wound site infection had significantly longer hospitalisation ($p < 0.001$). In the group with infection, 26.7% were hospitalized for 10 days or more, while this rate was 2.1% in the group without infection. These delays in adjuvant treatment may have a negative effect on cancer-specific survival rates. Long-term data is needed to evaluate the impact of these delays on early recurrence and mortality.

In patients with a history of previous abdominal surgery, the incision may be made through the same incision as the previous surgery in accordance with the operation plan, so poor healing can be expected in patients with a history of surgery. The presence of adhesions, which can lead to technical difficulties during surgery, prolonged operation time, and thus increased contamination possibility, and more wound trauma due to prolonged and forceful retraction during surgery, are other reasons for increased wound complications in patients with a history of surgery. In our study, we found no difference in the development of wound infection between those with and without a history of surgery ($p = 0.031$).

In the present study, no significant correlation was identified between the age, height, weight, and BMI values of the patients and the development of wound infection ($p > 0.05$). However, previous studies have demonstrated that obesity can prolong wound healing times. Potential mechanisms by which obesity may impede wound healing include increased tension on the wound, the potential for additional trauma, and the possibility of necrosis of the abdominal wall due to stronger retraction during surgical procedures. Furthermore, the presence of skin folds in obese patients may serve as a reservoir for microorganisms, which can contribute to wound infection. The prevalence of wound complications in obese patients may also be attributed to relative hypoperfusion and ischemia in subcutaneous adipose tissue, thereby reducing the delivery of optimal tissue levels of prophylactic antibiotics (11,12).

Several earlier studies have suggested a link between longer operating times and an increased risk of surgical site infections (13,14). However, gynecologic oncologic operations are complex procedures that encompass a greater surface area compared to surgeries performed for benign indications and consequently entail longer operation times. In our study, the median operation time was 180 minutes for patients who developed surgical site infection, while this time was 120 minutes for patients who did not develop surgical site infection. The association between prolonged operative time and increased risk of surgical site infection has been attributed to various factors, including inadequate dosing of prophylactic antibiotics, tissue trauma due to instrumentation and manipulation, hypoglycaemia, hypothermia, blood loss, exposure to environmental pathogens, and violation of sterile technique (2,15,16).

In the study conducted by Subramaniam et al., in patients undergoing caesarean section, it was found that increased skin incision length was not independently associated with increased risk of postoperative wound complications (17). Ioannidis et al. demonstrated that inflammatory and immune responses triggered by surgical trauma applied only to the skin are closely related to the length of the skin incision (18). In the clinical data presented here, it was observed that an increase of 1 cm in the length and depth of the incision was associated with an elevated probability of wound infection. According to the results of the ROC analysis of our study, the cut-off value for incision length was 15.5 cm and the cut-off value for incision depth was 8.5 cm. In operations with an incision length of 15.5 cm or a incision depth of 8.5 cm, wound infection should be considered a high risk.

Neoadjuvant chemotherapy is employed to facilitate surgical intervention by reducing the size of unresectable tumours in patients with gynaecological oncological conditions. In advanced epithelial ovarian cancers, neoadjuvant chemotherapy followed by intermittent debulking surgery has been demonstrated to be a reasonable

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approach for patients considered inoperable (19). The feasibility and efficacy of interval debulking surgery following neoadjuvant chemotherapy in unresectable metastatic endometrial cancers have also been demonstrated (20).

In the literature, studies examining the effect of neoadjuvant chemotherapy on wound infection in abdominal surgeries performed after NAC are quite limited. In the meta-analysis by Zhang et al., examining the effect of neoadjuvant chemotherapy on WI after emergency breast reconstruction, the incidence of WI was found to be higher in the group receiving NAC compared to the control group, but the difference between the two groups was not statistically significant (21). In a study by Doo et al., the relationship between postoperative complications in patients operated for ovarian cancer was examined between the group receiving preoperative chemotherapy and the group not receiving preoperative chemotherapy. A higher organ/space infection rate and a higher blood transfusion rate were observed in the group receiving neoadjuvant chemotherapy compared to those not receiving chemotherapy (22). In the present study, the risk of developing WI was found to be approximately 14 times higher in patients receiving neoadjuvant chemotherapy. Although impaired immunity is thought to facilitate the development of WI in malignant cases, we think that the increased incidence of WI in the group of patients who received neoadjuvant chemotherapy may be related to the more complicated operation, increased transfusion need and longer operation time. Randomized controlled trials are needed to determine the cause of WI in patients receiving neoadjuvant chemotherapy.

Although blood transfusions are occasionally necessary in major surgery, there is an increasing body of evidence that they are associated with several postoperative complications. In the patient group under consideration, the requirement for blood transfusion was associated with an elevated risk of WI, a finding that is consistent with the results of previous studies (23). The potential risks associated with increased WI following blood transfusion are yet to be elucidated. These risks are likely to arise from a combination of decreased oxygen carrying capacity and delivery to tissues due to anaemia, as well as adverse, dose-dependent effects on fluid balance, contamination, and host immune response (24-25)

The main limitation of this study is the retrospective evaluation of wound infections following gynaecological surgery performed at a single institution. Therefore, the findings are limited to the patient profile, surgical practices, and infection control protocols of the hospital where the study was conducted. Considering the differences in patient groups and practices in different healthcare institutions, it may not be possible to transfer these results to other institutions or to a generalized context. Because our study is specific to our clinic, we believe that caution should be exercised when interpreting the results on a broader scale.

The study concluded that WIs occurred in 11.4% of cases following laparotomy for gynecologic oncology malignancies. The most significant factors identified as predictors of these complications were found to be neoadjuvant chemotherapy and the need for transfusions. The main finding of our study was that incision depth and length were identified as risk factors.

During gynecologic oncologic operations, it is crucial to avoid extending incisions unnecessarily to reduce the risk of WI. Meticulous dissection techniques should be employed to avoid bleeding and the potential need for transfusions. The postoperative process should be followed carefully in patients with a history of neoadjuvant chemotherapy. Wound management for patients with an incision length of 15.5 cm and an incision depth of 8.5 cm should be carried out carefully and monitored closely. Because our study was conducted at a single center, multicenter prospective studies with larger and adequately powered sample sizes are necessary to validate our findings.

Acknowledgment

The authors have no relevant financial or non-financial interests to disclose.

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