

The Impact of Temporal Factors on Surgical Site Infections: A Comparison of the Pre-Pandemic and Pandemic Periods

Cerrahi Alan Enfeksiyonlarında Dönemsel Faktörlerin Etkisi: Pandemi Öncesi ve Dönemi Karşılaştırması

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ABSTRACT

Aim: This study aims to investigate the impact of the COVID-19 pandemic on the incidence of surgical site infections (SSIs), to identify associated risk factors, and to propose evidence-based strategies for reducing morbidity, mortality, and healthcare-related costs.

Methods: The study included 5,064 patients who underwent surgery between March 1, 2018, and March 1, 2022, at the University of Health Sciences, Bağcılar Training and Research Hospital. Patients who developed surgical site infections (SSIs) within 30 days postoperatively were evaluated. A total of 62 cases occurred prior to the COVID-19 pandemic, and 39 cases were identified during the pandemic period.

Results: A total of 2,864 patients underwent surgery before the COVID-19 pandemic, and 2,200 patients during the pandemic. Among these, 287 (10%) and 274 (12.5%) procedures were gynecological surgeries, respectively. Surgical site infections (SSIs) were identified in 62 patients (2.2%) prior to the pandemic and in 39 patients (1.8%) during the pandemic. The mean age of the patients was 33 ± 10 years, and the mean body mass index (BMI) was 33 ± 7 . The majority of procedures were cesarean sections, with 96% of incisions performed using the Pfannenstiel technique. Overall, 21% of the patients were smokers, 42% had a history of prior surgery, and 19% had at least one comorbid condition.

Conclusion: Although a decrease in the rate of surgical site infections (SSIs) was observed during the COVID-19 pandemic compared to the pre-pandemic period, this difference was not statistically significant. Our findings suggest that adequate infection prevention measures were effectively implemented both before and during the pandemic, and that the additional precautions introduced in response to the pandemic did not have a significant impact on reducing the incidence of SSIs.

Key words: Surgical site infection, COVID-19 pandemic, Pfannenstiel incision

ÖZ

Amaç: Bu çalışma, COVID-19 pandemisinin cerrahi alan enfeksiyonlarının (CAE) insidansı üzerindeki etkisini araştırmayı, ilişkili risk faktörlerini belirlemeyi ve morbidite, mortalite ile sağlık hizmeti maliyetlerini azaltmaya yönelik kanıta dayalı stratejiler önermeyi amaçlamaktadır.

Yöntem: Bu çalışma, 1 Mart 2018 ile 1 Mart 2022 tarihleri arasında Sağlık Bilimleri Üniversitesi Bağcılar Eğitim ve Araştırma Hastanesi'nde ameliyat edilen 5.064 hastayı kapsamaktadır. Ameliyat sonrası 30 gün içinde cerrahi alan enfeksiyonu (CAE) gelişen hastalar değerlendirilmiştir. Pandemi öncesi dönemde 62, pandemi döneminde ise 39 olgu tespit edilmiştir.

Bulgular: COVID-19 pandemisi öncesinde 2.864, pandemi döneminde ise 2.200 hasta cerrahi operasyon geçirmiştir. Bu hastalar arasında sırasıyla 287 (%10) ve 274 (%12,5) olgu jinekolojik ameliyatlardan oluşmaktaydı. Cerrahi alan enfeksiyonu (CAE), pandemi öncesi dönemde 62 hastada (%2,2), pandemi döneminde ise 39 hastada (%1,8) tespit edilmiştir. Hastaların ortalama yaşı 33 ± 10 yıl, ortalama beden kitle indeksi (BKI) ise 33 ± 7 idi. Uygulanan işlemlerin çoğunluğunu sezaryenler oluşturmakta olup, insizyonların %96'sı Pfannenstiel tekniği ile yapılmıştır. Hastaların %21'i sigara kullanıcısıydı, %42'sinde daha önce geçirilmiş cerrahi öyküsü mevcuttu ve %19'unda en az bir komorbid hastalık bulunmaktaydı.

Sonuç: COVID-19 pandemisi döneminde, pandemi öncesi döneme kıyasla cerrahi alan enfeksiyonu (CAE) oranlarında bir azalma gözlemlenmiş olsa da, bu fark istatistiksel olarak anlamlı bulunmamıştır. Bulgularımız, enfeksiyon önleme önlemlerinin hem pandemi öncesinde hem de pandemi sırasında etkin bir şekilde uygulandığını ve pandemiye yönelik ek önlemlerin CAE insidansını azaltma üzerinde anlamlı bir etkisinin olmadığını göstermektedir.

Anahtar kelimeler Cerrahi alan enfeksiyonu, COVID-19 pandemisi, Pfannenstiel insizyonu

Received Date: 23.12.2024 / Accepted Date: 27.05.2025 / Published (Online) Date: 31.12.2025

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To cited: Aybek ÖY, Ceylan Y, Kovalak EE, Karacan T, Güraslan H. The effect of precautions taken in the COVID-19 pandemic on surgical site infections. Acta Med. Alanya 2025;9(3):222-227 DOI: 10.30565/medalanya.1605845

Introduction

According to the Centers for Disease Control and Prevention (CDC) in the United States, a surgical site infection (SSI) is defined as an infection occurring near the surgical incision within 30 days of following a surgical procedure [1]. Risk factors for postoperative wound infections include advanced age, poor nutritional status, diabetes mellitus, smoking, obesity, concurrent infections at other body sites, immunosuppressive therapy, prolonged preoperative waiting time, inadequate surgical hand hygiene, improper surgical site preparation, preoperative shaving, extended operation duration, lack of antimicrobial prophylaxis, poor operating room ventilation, insufficiently sterilized surgical instruments, the presence of foreign material in the surgical field, and suboptimal surgical techniques [2]. A well-implemented infection control program can reduce the incidence of SSIs by up to 40% [3].

Postoperative SSIs remain a longstanding and significant clinical challenge. Despite improvements in healthcare systems over the years having contributed to a decline in infection rates, SSIs continue to pose a serious threat to patient safety. Various guidelines outline comprehensive preoperative, intraoperative, and postoperative measures aimed at minimizing the risk of infection [4]. During the COVID-19 pandemic, both patients and healthcare providers have placed increased emphasis on hygiene practices. Furthermore, contact and droplet precautions were introduced for the care of suspected COVID-19 cases, supplementing standard preventive measures.

This study aims to investigate the relationship between surgical site infections (SSIs) and the COVID-19 pandemic, identify associated risk factors, and propose strategies to reduce morbidity, mortality, and healthcare-related costs.

Methods

This retrospective observational study was approved by the institutional ethics committee on May 25, 2022, in accordance with decision number 131. Patients who developed a surgical site infection (SSI) within 30 days following surgery between 2018 and 2022 were included in the study. A total of 2,864 patients who underwent surgery

at the Gynecology and Obstetrics Clinic of the University of Health Sciences, Bağcılar Training and Research Hospital, before the COVID-19 pandemic, and 2,200 patients operated on during the pandemic period, were screened. Among these subjects, 62 patients (2.2%) developed postoperative SSIs prior to the pandemic, while 39 patients (1.8%) experienced SSIs during the pandemic. Patient data were obtained from archival records and the hospital information system. The collected variables included age, body mass index (BMI), type of surgery, presence of comorbidities, use of antibiotic prophylaxis, type of incision, C-reactive protein (CRP) levels, smoking status, history of previous surgeries, culture results, history of COVID-19 infection, classification of infection (superficial, deep, or organ/space), and the need for debridement or secondary suturing.

During the COVID-19 pandemic, in addition to standard surgical aseptic protocols, contact and droplet isolation measures were implemented in the preoperative and postoperative care of patients. Every patient was tested for COVID-19 preoperatively. Those who tested negative proceeded to surgery; whereas patients with positive results but without an urgent surgical indication had their procedures postponed. Patients requiring emergency intervention were operated on regardless of COVID-19 status, followed by strict postoperative isolation. Healthcare professionals were required to wear masks and gloves and to disinfect their hands meticulously during all postoperative interactions.

Patients were excluded from the study if their infections occurred more than 30 days after surgery, or if they had cellulitis or folliculitis at the incision site, were undergoing immunosuppressive therapy, had an allergy to povidone-iodine, or had an active oncologic condition. Every patient without a known drug allergy received 2 g of intravenous cefazolin prophylactically in accordance with surgical guidelines, with an additional dose administered if the operation exceeded four hours in duration. Surgical site antisepsis was performed with 10% povidone-iodine in every cases. In patients who presented with SSIs, hemogram, CRP levels, and wound cultures were routinely evaluated.

Statistical analysis

Statistical analyses were performed using IBM SPSS Statistics version 20. A p-value of <0.05 was considered statistically significant. Descriptive statistics for continuous variables included mean $\pm$ standard deviation, median, minimum, and maximum values, while categorical variables were expressed as percentages. The Kolmogorov-Smirnov test was used to assess the normality of data distribution. The Mann-Whitney U test was employed to compare continuous variables between two independent groups. For categorical variables, Chi-square and Fisher's exact tests were applied. A 95% confidence interval was used for every statistical evaluations.

Results

Prior to the pandemic, 287 out of 2,864 patients (10%) underwent gynecological operations, while 2,577 patients (90%) underwent cesarean sections. During the pandemic, of the 2,200 surgical procedures performed, 274 (12.5%) were gynecological surgeries and 1,926 (87.5%) were cesarean sections. The study included 101 patients who developed surgical site infections (SSIs): in particular 62 patients (2.2%) before the pandemic and 39 patients (1.8%) during the pandemic.

Except for the additional contact and droplet isolation measures implemented during the pandemic period, no statistically significant difference was observed in the SSI risk factors between the pre-pandemic and pandemic groups. The two groups were similar in terms of age, body mass index (BMI), smoking status, comorbidities, type of incision, and history of previous surgery.

The mean age of patients was 33 ± 10 years (range: 17–74), and the mean BMI was 33 ± 7 . Among the patients with SSIs, 61.4% ($n = 62$) were from the pre-pandemic group, and 38.6% ($n = 39$) from the pandemic group. Overall, 67.2% of the operations were cesarean sections, 96% of which were performed using a Pfannenstiel incision. Smoking was reported in 21.2% of patients; 42% had a history of previous surgery, and 19% had at least one comorbid condition, including diabetes mellitus, hypertension, or hypothyroidism (Table 1).

Positive wound cultures were observed in 55.4% of patients ($n = 56$), with *Staphylococcus aureus* being the most commonly isolated microorganism (19.6%). No statistically significant differences were observed in the culture positivity rates or in the distribution of superficial, deep, or organ/space infections between the pre-pandemic and pandemic groups.

Table 1: Demographic characteristics of the patients

	Mean $\pm$ SD Median (Min-Max)	
Age (years)	33 $\pm$ 10 / 33 (17-74)	
BMI	33 $\pm$ 7 / 32 (21-50)	
Period	N	%
Pre-Pandemic period	62	61.4
Pandemic period	39	38.6
Operation type	N	%
Cesarean section (CS)	68	67.2
Myomectomy	6	5.9
Cystectomy	2	2.0
Total abdominal hysterectomy with bilateral salpingectomy (TAH+BS)	5	5.0
Total abdominal hysterectomy with bilateral salpingo-oophorectomy (TAH BSO)	13	12.9
Total abdominal hysterectomy with unilateral salpingo-oophorectomy (TAH USO)	2	2.0
Sacrocolpopexy	1	1.0
Salpingectomy	1	1.0
Serosel	1	1.0
Scar endometriosis	1	1.0
Abscess	1	1.0
Incision	N	%
Pfannenstiel (PF)	97	96
Upper midline incision (UMI)	2	2.0
UMI+ Lower midline incision (LMI)	2	2.0
Cigarette smoking	N	%
Yes	22	21.2
No	79	78.2
Operation passed	n	%
Yes	42	42
No	58	58
Comorbidity	n	%
Yes	20	19.8
No	81	80.2

The mean CRP level among all the patients was 117.8 ± 102.2 mg/L, with a minimum value of 2 and a maximum of 451.

Surgical site infection was observed in 2.2% ($n = 62$) of the 2,864 surgical procedures performed

before the pandemic and in 1.8% (n = 39) of the 2,200 procedures performed during the pandemic. This difference was not statistically significant ($p > 0.05$) (Table 2).

Table 2: Comparison of the rates of surgical site infection in patients undergoing surgical procedures before and during the pandemic

Period	Surgical Site Infection None		Surgical Site Infection Yes		Test Statistic	p
	n	%	n	%		
Pre-pandemic	2802	97.8	62	2.2	$\chi^2 = 0.979$	0.323
Pandemic period	2161	98.2	39	1.8		

No significant differences were identified in the number of Pfannenstiel incisions between the two periods ($p > 0.05$) (Table 3). Similarly, there were no statistically significant differences in comorbidities, culture positivity, or smoking status between the pre-pandemic and pandemic groups ($p > 0.05$).

Table 3: Comparison of incision types of patients with surgical site infections before and during the pandemic

Incision	Pre-pandemic		Pandemic period		p
	N	%	N	%	
PF	59	95.2	38	97.4	1.000
Other	3	4.8	1	2.6	

Due to the limited variety of isolated microorganisms, a detailed comparison of specific species could not be performed. Microorganisms were grouped for analysis, but no significant differences were found in their distribution between the two study periods ($p > 0.05$).

Every patient was questioned regarding prior COVID-19 infection before or during surgery, with none reporting any history of COVID-19.

Discussion

During the COVID-19 pandemic, both patients and healthcare professionals began to place increased emphasis on hygiene practices. In addition to standard infection prevention measures, contact and droplet isolation protocols were incorporated into the care of patients suspected of having COVID-19.

In a study by Antonello et al. evaluating surgical

site infections (SSIs) following cesarean sections during the COVID-19 pandemic, an increase in the use of personal protective equipment (PPE) by healthcare workers was reported. Although a reduction in SSI rates was observed, the difference was not statistically significant [5]. Similarly, in our study, a numerical decrease in SSI rates was observed during the pandemic compared to the pre-pandemic period; however, this difference was not statistically significant ($p > 0.05$).

Numerous studies have identified *Staphylococcus aureus* as the most frequently isolated microorganism in wound cultures from patients with SSIs [6]. Consistent with these findings, our study found positive culture results in approximately half of the cases, with *S. aureus* being the most commonly.

In a study conducted by Pantvaidya et al., which assessed SSIs in patients undergoing major oncologic surgeries during the pandemic, a 23% reduction in SSI rates was reported. This study included patients with breast, head and neck, gastrointestinal, musculoskeletal, urological, gynecological, and central nervous system cancers [7]. A statistically significant decrease in superficial SSIs was observed, while reductions in deep and organ/space infections did not reach statistical significance. In contrast, our study did not demonstrate a significant difference in SSI rates between the pre-pandemic and pandemic periods.

Losurdo et al. investigated the impact of COVID-19 quarantine measures on SSIs in general surgery patients, including those undergoing thyroid, breast, hepatobiliary, and colorectal surgeries. Their study reported a significant decrease in overall SSI rates during the pandemic. Notably, reductions were observed across superficial, deep, and organ/space infections. Furthermore, no significant differences were found between emergency and elective procedures [8]. In our study, there were likewise no statistically significant differences between emergency and elective surgeries, nor were there any among the categories of superficial, deep, or organ/space infections. When we compared the frequency of surgical site infections after hysterectomies with our study in which Lachiewicz et al. examined

infections after gynecological surgeries, we found a greater rate compared to the study by Lachiewicz et al [9]. However, when we compared the pre-pandemic and pandemic periods of the COVID-19 pandemic, we observed a decrease.

When comparing our SSI rates following hysterectomies with the findings of Lachiewicz et al., who examined infections after gynecologic surgeries, our rates appeared higher. However, within our own study, a decline in SSI incidence was observed during the pandemic compared to the pre-pandemic period.

Several studies attribute the observed decline in SSI rates during the pandemic to enhanced hand hygiene, widespread use of face masks, and strict adherence to physical distancing between patients and healthcare workers. This interpretation is consistent with findings from other national studies emphasizing the critical role of these preventive measures in minimizing infection risk [10]. Although our study showed a numerical decrease in SSI rates during the pandemic, the difference was not statistically significant. We interpret this finding as an indication that effective infection control measures were already in place in our clinic prior to the pandemic and were consistently maintained throughout the study period.

The main limitations of our study include the relatively small sample size, its single-center design, and the absence of detailed data regarding the duration of surgical procedures. While existing guidelines offer recommendations, randomized controlled trials are warranted to establish standardized protocols for the prevention of postoperative SSIs.

Conclusion

A review of the literature reveals that numerous studies have compared surgical site infection (SSI) rates before and during the COVID-19 pandemic across various surgical fields, including thyroid, breast, hepatobiliary, colorectal, head and neck, thoracic, orthopedic, urological, and neurosurgical procedures. However, studies focusing on obstetric and gynecologic surgeries remain limited in number.

Although our study observed a numerical

decrease in SSI rates during the pandemic period compared to the pre-pandemic period, this difference was not statistically significant. Based on these findings, we conclude that effective infection prevention measures were already in place prior to the pandemic and that the additional precautions implemented during the pandemic—such as enhanced hygiene practices and isolation protocols—did not significantly impact SSI rates in our patient population.

Conflict of Interest: The authors declare no conflict of interest related to this article.

Funding sources: The author declare that this study has received no financial support.

Ethics Committee Approval: In this study, national and international ethical rules are observed. Ethic Board: Health Sciences University Kanuni Sultan Süleyman Training and Research Hospital, 25.05.2022 / 131

ORCID and Author Contribution: **Ö.Y.A. (0000-0003-0332-496X):** Conceptualization, Data collection, Writing - Original Draft. **Y.C. (0000-0001-5517-8461):** Data analysis, Methodology, Writing - Review & Editing. **E.E.K. (0000-0001-5311-1060):** Supervision, Literature Review. **T.K. (0000-0002-3510-4147):** Statistical analysis, Validation. **H.G. (0000-0003-3033-985X):** Project administration, Final approval. All authors read and approved the final version of the manuscript.

Peer-review: Externally peer reviewed.

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