ORIGINAL RESEARCH

Bagcilar Med Bull 2023;8(3):216-221
DOI: 10.4274/BMB.galenos.2023.2022-12-105

Evaluation of Post-cesarean Section Surgical Site Infections Before and During the COVID-19 Pandemic: Retrospective, Tertiary Center Experience

Sezaryen Sonrası Cerrahi Alan Enfeksiyonlarının COVID-19 Pandemisi Öncesi ve Sırasında Değerlendirilmesi: Retrospektif, Tersiyer Merkez Deneyimi

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Abstract

Objective: Surgical site infection (SSI) significantly causes maternal morbidity requiring hospitalization. This study aimed to determine the clinical and laboratory results of patients who developed SSI after cesarean section at the peak of Coronavirus disease-2019 (COVID-19).

Method: Sixty patients who developed SSIs after cesarean section were included in the study retrospectively. They were divided into two groups. Thirty patients recruited at the peak of COVID-19 were the "pandemic group" and thirty patients recruited in previous years were the "pre-pandemic group". Age, parity, presence of comorbidity, emergency or elective cesarean section, use of drain in operation, postoperative hemoglobin, hematocrit and leukocyte values, presence of superficial or deep incisional infection, time from discharge to wound infections, wound growth culture, antibiotic duration, length of hospital stay, and the need for suture performed were analyzed between the two groups.

Results: While superficial incisional infection was observed in 71.7% (n=43) of the patients with SSI, deep incisional infection was observed in 28.3% (n=17). It was observed that there was an increase in deep incisional infection rates and the need for suturation in SSIs during the pandemic period, but there was no significant difference (p=0.390). There was no significant difference in hemoglobin, hematocrit, and leukocyte values. However, it was observed that all patients with deep incisional infections were sutured (p<0.001).

Conclusion: SSI causes prolonged hospital stays, poor delivery experience, and patient dissatisfaction. Demographic characteristics of patients and surgical factors are essential in determining the risk.

Öz

Amaç: Cerrahi alan enfeksiyonu (CAE) hastaneye yatış gerektiren önemli bir derecede maternal morbiditeye neden olur. Bu çalışma, Koronavirüs hastalığı-2019'un (COVID-19) zirve yaptığı dönemde sezaryen sonrası CAE gelişen hastaların klinik ve laboratuvar sonuçlarını belirlemeyi amaçladı.

Yöntem: Sezaryen sonrası insizyonel CAE gelişen 60 hasta retrospektif olarak çalışmamıza dahil edildi. İki gruba ayrıldılar. COVID-19'un pik yaptığı dönemde toplanan otuz hasta pandemi grubu kabul edildi ve önceki yıllarda görülen otuz hasta pandemi öncesi grup olarak kabul edildi. Yaş, parite, ek hastalık varlığı, acil veya elektif sezaryen, operasyonda dren kullanımı, postoperatif hemoglobin, hematokrit ve lökosit değerleri, yüzeysel veya derin insizyonel enfeksiyon varlığı, taburculuktan yara gelişimine kadar geçen süre, yara üreme kültürü, antibiyotik süresi, hastanede kalış süresi ve sütüre edilip edilmediği gibi parametreler iki grup arasında analiz edildi.

Bulgular: CAE gözlenen hastaların %71,7'sinde (n=43) yüzeyel insizyonel enfeksiyon görülürken, %28,3'ünde (n=17) derin insizyonel enfeksiyon görüldü. Pandemi döneminde CAE'de derin insizyonel enfeksiyon oranlarında ve sütürasyon ihtiyacında artış olduğu ancak anlamlı bir fark olmadığı görüldü (p=0,390). Hemoglobin, hematokrit ve lökosit değerlerinde anlamlı fark gözlenmedi. Ancak derin insizyonel enfeksiyonu olan hastaların tümünün sütüre edildiği görüldü (p<0,001).

Sonuç: CAE, hastanede kalış süresinin uzamasına, kötü doğum deneyimine ve hasta memnuniyetsizliğine neden olur. Hastaların demografik özellikleri ve cerrahi faktörler riskin belirlenmesinde esastır.

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Cite this article as: Çetin Arslan H, Arslan K, Göksu M. Evaluation of Post-cesarean Section Surgical Site Infections Before and During the COVID-19 Pandemic: Retrospective, Tertiary Center Experience. Bagcilar Med Bull 2023;8(3):216-221

Abstract

This study shows that although there is an increase in the frequency of deep incisional infections during the pandemic, post-cesarean section infections are not affected by the pandemic in terms of clinical and laboratory features.

Keywords: Cesarean section, morbidity, pandemic, surgical site infections

Öz

Bu çalışma, pandemi döneminde derin insizyonel enfeksiyonlarının sıklığında artış olmasına rağmen, sezaryen sonrası enfeksiyonların klinik ve laboratuvar özellikleri açısından pandemiden etkilenmediğini göstermektedir.

Anahtar kelimeler: Cerrahi alan enfeksiyonları, morbidite, pandemi, sezaryen

Introduction

Surgical site infections (SSI) are observed in the incision line or manipulated organs/areas and occur within the first 30 days after the operation. In the presence of a foreign body (prosthesis, implant, etc.), this period increases to one year. While SSIs cause surgery-related morbidity and mortality, they also severely burden countries' economies because of prolonged hospital stays.

By the middle of the 19th century, the incidence of SSIs reached 90%. This rate decreased with the discovery of antibiotics and the principles of asepsis/antisepsis by Joseph Lister (1). Today, the prevalence of SSI, the most critical complication of cesarean section operations, varies between 3% and 15% (2). It ranks third among infections requiring hospitalization (3).

Standard definitions for diagnosing SSI have been determined by the Centers for Disease Control and Prevention. They are classified as superficial infection, deep infection, and organ/space infection if involving structures deeper than muscle and fascia space (4). With COVID-19 infection, there was a period when potential morbidity and mortality increased. Therefore, new proposals specific to the pandemic were planned. As elective operations were postponed due to the COVID-19 pandemic, cesarean section surgery became one of the most frequently performed procedures.

This study aims to analyze the clinical and laboratory outcomes of SSIs after cesarean sections performed during the most intense COVID-19 compared to infections seen in previous years and to show the possible effects of the pandemic.

Materials and Methods

Ethical approval for this retrospective study was obtained from the University of Health Sciences Turkey, Kanuni Sultan Süleyman Training and Research Hospital Clinical Research Ethics Committee (28.07.2022/181). The study was initiated by the principles of the Declaration of Helsinki. The consent form was obtained from the patients before hospitalization.

Incisional CAE is considered purulent discharge, redness or swelling from the wound, and wound dehiscence, involving the skin and subcutaneous tissues within the first 30 days after the procedure. In the clinic, preoperative antibiotic prophylaxis is routinely administered to all patients at a dose of 1 g cefazolin 30-60 minutes before the incision. A total of 60 patients with diagnosed SSI who underwent elective and emergency cesarean sections between January 2018 and May 2022 were included in the study. The study sample was divided into two groups; the patients admitted between January 2018 and March 2020 were considered as the pre-pandemic group (n=30), and the patients between March 2020 and May 2022 were considered as the pandemic group (n=30). Demographic data such as age, parity, presence of additional disease, and clinical parameters such as emergency or elective cesarean section, use of drains in operation, presence of superficial or deep incisional infection, and organism cultured from wound swabs were compared in two groups. Laboratory parameters such as hemoglobin, hematocrit, and leukocyte values obtained within 24-48 hours after the operation and the duration of the antibiotic used, the duration of hospitalization, the time from discharge to wound development, and the need for suturing were compared. In managing SSI, one group had to be sutured, while one group was treated conservatively. The distribution of these parameters in the suturation group was also examined. The conservative group (n=21) consisted of patients who did not require secondary suturing and were treated only with antibiotics, and the re-suturing group (n=39) consisted of patients who underwent secondary suturing.

Statistical Analysis

All statistical analyses were performed using the Statistical Program for Social Sciences (SPSS) version 16.0 (SPSS Inc., Chicago, IL). The Shapiro-Wilk test was used to assess the normality of the distribution of variables. Independent t-tests were used to compare parameters with normal

distribution, and data were presented as mean ± standard deviation. In contrast, the Mann-Whitney U test was used to compare parameters with the non-normally distribution, and data were presented as medians. Fisher's Exact and chi-square tests were used to compare qualitative data. p-values less than 0.05 were considered statistically significant.

Results

A total of 60 patients diagnosed with SSI within 30 days postoperatively were included in the study. Preoperative antibiotic prophylaxis was determined in all patients. The mean age of the patients was 30.6±6.1 years and ranged from 19 to 41. The mean number of deliveries was 2.0±1.7 and all patients were multiparous. Ten patients (16.7%) had one or more additional diseases, such as hypertensive disease, anemia, and obesity. While comorbidity was observed more in the pandemic group, it did not reach a significant value. It was observed that the emergency or elective occurrence of the operation and the use of drains were similar between the two groups. While superficial incisional infections were observed in 71.7% (n=43) of the patients; deep incisional infections were observed in 28.3% (n=17). Although there was an increase in the frequency of deep incisional infections with the pandemic, it did not reach a significant difference (p=0.390). Cultures taken from wound swabs showed growth in 38.3% (n=23) of the patients. Reproducing organisms increased with the pandemic, but no significant difference was found. When the distribution of the patients who developed infections at the wound site after the operation were examined, Gram (+) bacteria were found in 48.3% of the patients, Gram (-) bacteria in 43%, and fungal growth in 8.7%. *Staphylococcus aureus* was the most frequently isolated pathogen, and *Enterococcus faecalis* was the second pathogen. Re-suturing was performed in 65% (n=39) of the patients who developed SSI, while only antibiotic treatment was applied in 35% (n=21) (Table 1).

When the laboratory results were examined, no significant difference was observed between hemoglobin, hematocrit, and leukocyte values (Table 2). The mean day on which SSI was diagnosed was 12.2±11.0 postoperative day. The mean duration of antibiotics was 14.0±5.7 days, and the average length of stay was 7.1±5.0 days. There was no significant difference in the duration of antibiotics and the length of stay between pre-pandemic and pandemic groups.

The clinical parameters of the patients treated conservatively, and those who needed suturing are compared in Table 3. Parameters such as age, deep incisional infection rate, presence of growth in wound culture, blood leukocyte values, hospital admission time after discharge, duration of antibiotics usage, and hospital stays were observed at higher rates in the group requiring suturing; however, no significant difference was found.

Table 1. Demographic data and distribution of clinical characteristics of the patients with surgical site infections, and comparison of study groups

	Total (n=60)	Pre-pandemic group (n=30)	Pandemic group (n=30)	p-value
Age (mean ± SD)	30.6±6.1	29.1±6.2	32.1±5.8	0.707
Parity (mean ± SD)	2.0±1.7	1.3±1.4	2.8±1.7	**0.001**
Comorbidity (n, %)	10 (16.7%)	4 (13.3%)	6 (20.0%)	0.488
Cesarean section (n, %)				0.793
Emergency	25 (41.7%)	12 (40.0%)	13 (43.3%)	
Elective	35 (58.3%)	18 (60.0%)	17 (56.7%)	
Drain use (n, %)	8 (13.3%)	5 (16.7%)	3 (10.0%)	0.448
Incisional infection (n, %)				
Superficial	43 (71.7%)	23 (76.7%)	20 (66.7%)	0.390
Deep	17 (28.3%)	7 (23.3%)	10 (33.3%)	
Organism cultured from wound swab	23 (38.3%)	10 (33.3%)	13 (43.3%)	0.426
Management of SSI (n, %)				0.417
Conservative	21 (35%)	12 (40.0%)	9 (30.0%)	
Re-suturing	39 (65%)	18 (60.0%)	21 (70.0%)	

SD: Standard deviation, SSI: Surgical site infections. p-value <0.05 is significant

It was observed that all patients with deep incision infections were sutured (p<0.001).

Discussion

Cesarean section operations are one of the most common abdominal surgeries performed worldwide. SSI complicates 2-5% of all surgeries and 5-12% of cesarean section surgeries (5,6). SSI is the second most common complication of urinary tract infection after delivery (7), and it also burdens the health system by prolonging the hospital stay.

Most SSIs are observed as superficial incisional, less often deep incisional, and organ/space. Wloch et al. (8) reported that superficial incisions were for 88.3% of infections. In our study, 71.7% were superficial, and 28.3% were deep incisional infections. It should be known that superficial infection may spread to deep tissues if the necessary antimicrobial treatment and care are not performed.

Causative microorganisms from wound swabs are often reported as diffuse skin or urogenital tract flora. *Ureaplasma urealyticum* 62%, followed by coagulase-negative *Staphylococcus aureus* 32%, and *Enterococcus faecalis* 28% were detected in cultures obtained from 939 post-cesarean SSIs (9). In a multicenter prospective study investigating SSI frequency and risk factors after cesarean section, causative microorganisms were reported in 39.8% of infections. The common isolated pathogen was found to be *Staphylococcus aureus* (40.4%) (8). Our analysis also has findings supporting this study. Causative microorganisms were reported in 38.3% of the infections, and the most commonly isolated pathogen was *Staphylococcus aureus*. The β-lactam antibiotics used for antimicrobial prophylaxis are suitable for targeting such organisms. Among the first-generation cephalosporins, cefazolin is generally preferred as first-line therapy. Clindamycin is recommended in combination with an aminoglycoside in patients with beta-lactam allergy (10).

In a study evaluating risk factors for SSI, age, high BMI, malnutrition, low socio-economic status, preoperative anemia, and co-morbidities were found to be associated (11). Johnson et al. (12) reported that the risk of SSI increases with age. On the other hand, in some studies in

Table 2. Clinical and laboratory outcomes and comparison of study groups

	Total (n=60)	Pre-pandemic group (n=30)	Pandemic group (n=30)	p-value
Postoperative hemoglobin (g/dL)	10.3±1.6	10.1±1.7	10.4±1.5	0.569
Postoperative hematocrit	31.5±4.8	30.8±5.1	32.3±4.5	0.287 (%)
Postoperative WBC counts (cells/µL)	13.7±6.7	13.2±5.8	14.2±7.6	0.569 (10^3)
Time from discharge to hospitalization (days)	12.2±11.0	13.3±14.2	11.1±6.7	0.988
Lenght of antibiotic use (days)	14.0±5.7	13.2±6.4	14.9±4.7	**0.028**
Lenght of hospital stay (days)	7.1±5.0	7.3±6.1	7.0±3.7	0.645

p-value <0.05 is significant. WBC: White blood cell

Table 3. Clinical characteristics and comparison of the conservative and re-suturing group

	Conservative group (n=21)	Re-suturing group (n=39)	p-value
Age (mean ± SD)	28.6±5.8	31.7±6.1	0.085
Incisional infection (n, %)			
Superficial	21 (100%)	22 (56.4%)	**0.001**
Deep	0	17 (43.6%)	
Organism from wound swab	9 (42.9%)	14 (35.9%)	0.597
Postoperative WBC counts (cells/µL)	11.7±4.3	15.0±7.5	0.161
Time from discharge to (days)	10.6±6.0	13.2±13.1	0.981
Lenght of antibiotic use (days)	13.1±3.9	14.6±6.5	0.300
Lenght of hospital stay (days)	5.5±2.0	8.0±6.0	0.116

SD: Standard deviation, p-value <0.05 is significant, WBC: White blood cell

the literature, the incidence of SSI was found to be more common in young women (<20 years), although the cause is unknown. There was no difference in the length of hospital stay in young women (13,14). In our study, the mean age of the study population was 30.6±6.1, and the mean parity was 2.0±1.7. Drain use, emergency or elective operation, and comorbidity were also evaluated as risk factors, but they were not significant between the groups.

In the clinic, leukocyte values taken from the blood are often checked for infection and complications in the postoperative period. However, available clinical and biological variables are not always associated with the severity of the infection (15). In our study, although there was a slight increase in the laboratory parameters of the patients during the pandemic period, they were not found to be significant.

SSIs usually occur 4-7 days after the operation but can be prolonged to 20 days. In the first 24 hours, it may also occur in the presence of clostridial infection and exotoxin-producing streptococcal infection. The follow-up period should be at least 21 days, preferably extended to 30 days after the operation. The literature showed signs of SSI ten days after surgery (8). In our study, SSI occurred 12.2±11.0 days after surgery, consistent with the literature.

A randomized controlled trial by Quinn et al. (16) conducted that uncomplicated dehiscence, shorter than 2 cm, being sutured unnecessarily, would heal with similar results without sutures. Similarly, in our study, there was no difference between conservative and re-suturing groups regarding clinical outcomes.

Study Limitations

This study has some limitations, some of which are the low number of patients and the fact that conducted in a single center retrospectively.

Conclusion

It is essential to determine the risk factors of post-cesarean infections to take the necessary precautions. At a time when maternal morbidity and mortality increased in the COVID-19 pandemic, no significant difference was observed in the clinical and laboratory outcomes of SSI patients. This may be because of the positive effect of infection control and the compliance of patients and healthcare personnel with the security measures applied during the pandemic.

Ethics

Ethics Committee Approval: Ethical approval for this retrospective study was obtained from the University of Health Sciences Turkey, Kanuni Sultan Süleyman Training and Research Hospital Clinical Research Ethics Committee (28.07.2022/181). The study was initiated by the principles of the Declaration of Helsinki.

Informed Consent: The consent form was obtained from the patients before hospitalization.

Peer-review: Internally and externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: H.Ç.A., M.G., Concept: H.Ç.A., K.A., Design: H.Ç.A., Data Collection or Processing: K.A., M.G., Analysis or Interpretation: K.A., M.G., Literature Search: M.G., Writing: H.Ç.A., K.A.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

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