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Original Research

Bacterial causes and antibiotics susceptibility profile of surgical site infection following cesarean section

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Abstract

Backround: Surgical site infection (SSI) is defined as an infection occurring within 30 days after a surgical operation and affecting either incision or deep tissues at the operation site. The aim of this study was to examine the incidence, identify bacterial agents and determine their antibiotics sensitivity of SSI following cesarean section (CS). **Methods**: This retrospective cohort study included women who undervent Misgav-Ladach method CS after which a SSI developed during the period from 01 January 2019 to 31 December 2019 at the Clinic for Gynecology and Obstetrics, University Clinical Center Tuzla. **Results**: During the observed period we recorded 3345 deliveries, out of which 946 (28.3%) were by cesarean section, and out of which 50 (5.28%) was with SSI. The most commonly isolated bacteria from SSI were: *Escherichia coli*; *Enterococcus faecalis*; *Staphylococcus aureus*; *Klebsiella pneumoniae*. Fluoroquinolnes had the highest antibacterial activity against gram-positive pathogenes isolated. *Staphylococcus aureus* isolates is highly resistant to penicilline (100%). **Conclusions**: The prevalence of SSI following cesarean section was high and *Enterococccus faecalis and Escherichia coli* was the commonest pathogens isolated.

Keywords: Caesarean section; Surgical site infection; Bacterial agents

1. Introduction

The prevalence of cesarean section (CS), one of the most commonly performed major surgeries, is increasing worldwide [1]. Surgical site infection (SSI) is defined as an infection occurring within 30 days after a surgery and affecting either incision or deep tissues at the surgical site [2,3]. SSI is a common complication after CS, described in 2–16% of women [1,2]. Furthermore, SSI was the most common nosocomial infection site and a most frequent cause of prolonged hospital stay [1,4]. Prophylactic antibiotics are recommended in women undergoing CS to decrease the risk of SSI [5]. Reported risk factors for SSI after CS; obesity, hypertensive disorders, chorioamnionitis, emergency CS, prolonged labour prior CS, prolonged rupture of membranes, multiple vaginal examinations, poor technique of the surgeon, prolonged surgery time, hemathoma and anaemia after surgery [1,3].

Complications of SSI include prolonged wound healing and course of antibiotics, wound dehiscence, secondary repair surgery and disfiguring scar, wound pain and intraabdominal surgical infections [3]. Others are the possibility of re-admission and in rare condition can lead to severe sepsis and mortality [3].

The common organisms causing SSI after CS in our hospital and their sensitivity patterns are unknown because no such study has been done in our centre and country. This gap makes the choice of empirical therapy more difficult to the clinicians. Therefore a better understanding of the spectrum of pathogens causing SSI as well as their sensitivity pattern in our department is important for prompt management [3].

However to date, no specific data exist for the incidence rate, risk factors and microbiological pathogens following CS in our country. To the best of our knowledge, this is the first study done in Bosnia and Herzegovina about SSI following CS in a tertiary hospital serving a large population.

The aim of this study was to examine the incidence, identify bacterial agents and determine their antibiotics sensitivity of SSI following CS which help to establish guidelines for the prevention, prompt and effective management of SSI.

2. Patients and methods

2.1 Patients

This retrospective cohort study included women who undervent Misgav-Ladach method CS [6] after which a SSI developed during the period from 01 January 2019 to 31 December 2019 at the Clinic for Gynecology and Obstetrics, University Clinical Center Tuzla. In our study we included 50 cases, with SSI. The Department for obstetrics service performs 3.300–3.700 deliveries a year, of which 25–30% are by CS. Full-time obstetric and fetal medicine subspecialist are available at Department from 8 AM to 4 PM, outside these hours, the Department is staffed by general specialist gynecologist and obstetrician, and the consultant is available on call offsite. In our study we included superficial/incisional SSI affecting the skin and subcutaneous tissue. Cases were included as having SSI in the presence of at least one of the following at the surgical site: purulent or sero-hemorrhagic discharge, pain/tenderness, swelling and/or erythema with or without fever (defined at temperature $\geq$38 °C) within 3 days of CS, and which were taken with a wound and lochia swab for microbiological analysis culture and antibiogram [7]. Excluding criteria were: Women with chorioamnionitis (defined as fever at least 38.0 °C plus fetal tachycardia [greater than 160 beats per minute] or purulent fluid from the cervical os) [5], women with urinary tract infection confirmed with positive urinoculture, patients who developed a SSI after discharge from the hospital, and patients who came to the hospital for a SSI, who underwent a caesarean section outside our institution.

The survey was approved by the Ethics Committee of the University Clinical Center Tuzla.

2.2 Methods

Data on the course of pregnancy and childbirth were collected on the basis of available medical records (mothers disease history). Obstetrical data included age of mothers at delivery, gestational age at delivery, duration of rupture of membranes. Data about SSI included duration of hospitalization, time between surgery to SSI, white blood cells count and C-reactive protein at time when wound and lochia swab was taken and at discharge, and wound and lochia culture and antibiogram results. Patients were divided into two groups: sterile swab (wound and lochia) group and non sterile swab (wound or lochia, or both) group.

The standard practice at our hospital is that all women having CS receive prophylactic antibiotics within 60 minutes of the surgery. Our hospital policy for antibiotics choice and dosage is cefazolin 2 g intravenously. In case of allergy on cefazolin we give azithromycin 500 mg intravenously. The most leading Obstetricians and Gynecologist associations recommend single dose intravenous 2 g cefasolin within 60 minutes prior to skin incision, as antibiotics prophylaxis [5,8]. Our standard surgical procedure after cutaneous disinfection with povidon iodine (for the first time) and Skinsept color® (for the second time, after drying the povidon iodine with a sterile compress) is a laparotomy by Joel-Cochen followed by a Misgav-Ladach method CS [6]. We did not clean and prepped the vagina before surgery other than disinfecting the vulva in the same way as the operative field (povidon iodide and Skinsept color®). Use of sutures (intracutaneous continuously or single reverse) for the skin incision are at the discretion of the surgeon. After cleaning with povidone iodide, a sterile dressing is placed on the wound after the surgery, which lasts until the third postoperative day. On the third postoperative day, a regular wound dressing is performed, when possible SSI can be verified. Wound swabs for microbiologic culture were taken from the SSI using sterile swabs sticks before the wound is cleaned with an antiseptic solution and sent to the hospital laboratory immediately for microscopic, culture and sensitivity. Menagement of an incisional abscess in our study was done by opening and drainaging the wound by obstetrician [2]. All purulent and necrotic material should be removed with toilet of wound 2–3 times per day with hydrogene, saline and povidone iodide [2]. Patients were treated with a board spectrum antibiotic (Cefazoline, Metronidazole or Gentamicin) initially, until arrival culture and antibiogram results. Parenteral antibiotics were continued till 24 hours after patients is a febrile and asymptomatic, followed by oral antibiotics to complete a 12-day course [2]. After the wound becomes clear, with no signs of infection and pus, which usually takes 5–7 days, a resuture was planned. Clinic practice is to discharge the patient in the third postoperative day after CS if the patient is in good condition.

2.3 Statistical analysis

Descriptive statistics, mean value, standard deviation (SD), percentage were used in statistical data processing. The student *t*-test and Mann Whitney U test were used to determine statistical significance of difference between the set of two data. Statistically significant difference was set to less than 5%. For statistical analysis we used SPSS 24.0 (version 24.0, IBM Corp., Chicago, IL, USA).

3. Results

During the observed period we recorded 3345 deliveries, out of which 946 (28.3%) were by cesarean section, and out of which 50 (5.28%) was with SSI. In our study we did not have cases with necrotizing fasciitis. In our study was no need for any patient to return to the operating room. SSI and lochia swab was sterile in 11 (22%) women, and in 39 (78%) women was isolated different bacterial species ($p < 0.0001$).

Table 1. Characteristics of patients with sterile and non sterile swab.

Characteristics	Sterile swab group	Non sterile swab group	Total	*p*
Total number N (%)	11 (22)	39 (78)	50 (100)	0.05
Average years of life	28.3 ± 5.8 (21–38)	27.3 ± 5.1 (20–39)	27.6 ± 5.2 (20–39)	0.297 (NS)
Average gestational age in weeks	38 ± 1.65 (35–40)	38.9 ± 1.4 (35–41)	38.6 ± 1.5 (35–41)	0.036
Average length of stay in days	5.4 ± 1.4 (4–9)	7.52 ± 3.7 (3–19)	7.02 ± 3.4 (3–19)	0.030
Premature rupture of membranes N (%)	7 (26.9)	19 (36.5)	26 (52)	0.384 (NS)
Duration of premature rupture of membranes (hours)	2.8 ± 3.5 (1–11)	6.7 ± 8.5 (1–30)	5.8 ± 7.7 (1–30)	0.063 (NS)
CRP concentration (mg/dL) at time when swab was taken	76.9 ± 86.1 (25.2–240.3)	98.1 ± 104.8 (3.3–386.3)	93 ± 100.2 (3.3–386.3)	0.264 (NS)
CRP concentration (mg/dL) at time of discharge	38.6 ± 58.6 (5–159.2)	31.5 ± 42.5 (1–150)	33.3 ± 46.3 (1–159.2)	0.323 (NS)
WBC at time when swab was taken (from to)	14.3 ± 4.4 (8.5–23.6)	15.3 ± 5.8 (7.7–30.36)	15 ± 5.5 (7.7–30.36)	0.291 (NS)
WBC at time of discharge	10.2 ± 1.9 (7.6–13.8)	9.8 ± 1.7 (6.4–13.6)	9.9 ± 1.7 (6.4–13.8)	0.224 (NS)
Open wound treatment N (%)	2 (18.1)	13 (33.3)	15 (30)	0.128 (NS)

Data are expressed as mean-SD (range) or as frequency (%), *CRP-C reactive protein, **WBC-White blood cells, ***NS-non significant.

Average age in group with sterile swab was 28.3, in group with non sterile swab was 27.3 (Table 1). Average gestational age was significantly lower in sterile swab group ($p < 0.036$) (Table 1). Duration of hospitalization was statistically significant lower in group with sterile swab ($p < 0.03$) (Table 1). Prevalence and duration from rupture of membranes to delivery was without statistical significance between groups ($p < 0.311$ and $p < 0.063$) (Table 1).

C-reactive protein and white blood cells count was statistically significantly higher at the time of swab taking in compared to hospital discharge in non sterile group ($p < 0.000261$ and $p < 0.00001$) (Table 1).

The wound must to be opened and treated in 2 (18.1) patients in sterile group and in 13 (33.3) in non sterile group (Table 1).

Gram-negative organisms were the most common isolates among SSI pathogens with prevalence 56.5%. The most commonly isolated bacteria from SSI were: *Escherichia coli*; *Enterococcus faecalis*; *Staphylococcus aureus*; *Klebsiella pneumoniae.* The most commonly isolated bacteria from lochia were: *Escherichia coli*; *Enterococcus faecalis*; *Klebsiella pneumoniae* (Table 2).

There is a significant difference between the two examined groups (wound and lochia) when we compared the total number of isolated bacteria ($p = 0.000215$) (Table 2).

There is a significant difference between the two examined groups (wound and lochia) when we compared the number of different species of isolated bacteria ($p = 0.047$). *Enterococcaceae* and *Enterobacteriaceae* were frequent in lochia, but *Staphylococcaeae* were frequent in wound (Table 2).

In four (16.6%) samples from SSI, out of 26, were isolated per two different bacterial species. In 12 (23%) samples from lochia, out of 52, were isolated per two different bacterial species, and in four (7.7%) were isolated per three different bacterial species. In 10 (20%) patients pathogens of the wound coincide with that of the lochia. The pathogens that coincided in the wound and lochia are:

Table 2. Bacterial species in wound and lochia swab.

Bacterial species	Wound	Lochia	Total	*p*
Total number	26	52	78	0.000215*
Enterococcaceae	**6 (23)**	**21 (40.3)**	**27 (34.6)**	**0.131****
Enterococcus faecalis N (%)	6 (23)	21 (40.3)	27 (34.6)	
Enterobacteriaceae	**15 (57.5)**	**29 (55.7)**	**44 (56.4)**	**0.872****
Escherichia coli N (%)	7 (26.9)	19 (36.5)	26 (33.3)	
Klebsiella pneumoniae N (%)	3 (11.5)	6 (11.5)	9 (11.5)	
Proteus mirabilis N (%)	1 (3.4)	2 (3.8)	3 (3.8)	
Enterobacter species N (%)	2 (7.6)	1 (1.9)	3 (3.8)	
Citrobacter koserii N (%)	1 (3.4)	-	1 (1.2)	
Morganella morgani N (%)	1 (3.4)	-	1 (1.2)	
Pseudomonas aeruginosa N (%)	-	1 (1.9)	1 (1.2)	
Staphylococcaceae	**5 (19.2)**	**2 (3.8)**	**7 (8.9)**	**0.0251****
Staphylococcus aureus N (%)	5 (19.2)	2 (3.8)	7 (8.9)	

*student *t* test, **Z test of two proportions, Bold data, Bacteria Families.
dF = 1, $p = 0.047$.

Escherichia coli 6 (60%); *Enterococcus faecalis* 3 (30%) and *Staphylococcus aureus* 1 (10%).

Antibiotics resistance was demonstrated by both the gram-positive and gram-negative pathogenes. Fluoroquinolnes had the highest antibacterial activity against gram-positive pathogenes isolated. Amikacine and imipenem had the highest antibacterial activity against gram-negative pathogenes. Among the *Escherichia coli* isolates, the majority is highly resistant to ampicilline (73%). *Enterococcus faecalis* isolates had moderate sensitivity to doxocycline (74%). *Klebsiella pneumoniae* isolates is higly resistant to amoxicilline/clavulanic acide (55.5%), and ampicilline (100%). *Staphylococcus aureus* isolates is highly resistant to penicilline (100%). Results of antimicrobial sensitivity of bacterial species found in wound and lochia swab were shown in Tables 3,4,5.

Table 3. Results of antibiogram for *Enterococcus faecalis* found in wound and lochia swab.

Antibiotics susceptibility profile N (%)	*Enterococcus faecalis*	
	S	R
AMP	27 (100)	-
CIP	27 (100)	-
DOX	20 (74)	7 (26)
GEN	23 (85)	4 (15)
LEV	27 (100)	-
NOR	26 (96.2)	1 (3.7)
NIT	27 (100)	-
VAN	27 (100)	-

S, sensitive; R, resistant; AMP, Ampiciline; CIP, Ciprofloxacine; DOX, Doxocyclin; GEN, Gentamycine; LEV, Levofloxacin; NOR, Norfloxacin; NIT, Nitrofurantoin; VAN, Vancomycin.

Table 4. Results of antibiogram for *Staphylococcus aureus* found in wound and lochia swab.

Antibiotics susceptibility profile N (%)	*Staphylococcus aureus*	
	S	R
AMK	5 (71)	2 (29)
CEF	7 (100)	-
CLI	7 (100)	-
CIP	7(100)	-
ERI	6 (85)	1 (15)
GEN	4 (57.1)	3 (42.8)
LIN	7 (100)	-
OX	7 (100)	-
PEN	-	7 (100)
TR/SUL	7 (100)	-
VAN	7 (100)	-

S, sensitive; R, resistant; AMK, Amikacin; CEF, Cefoksitin; CLI, Clindamycine; CIP, Ciprofloxacine; ERY, Eritromycine; GEN, Gentamycine; LIN, Linezolid; OX, Oxacilin; PEN, Penicilin; TR/S, Trimetoprim/Sulfmetoxasol; VAN, Vancomycin.

4. Discussion

The study gives an insight into the microbiological causative pathogens of SSI in our hospital and their sensitivity profiles. Reported prevalence SSI after CS ranging from 2% to 10%, which is fits with our data, 5.28%, respectively [1,3,4]. The possible reason for differences in these studies could be attributed to population differences; pre-existing diseases, use of prophylactic antibiotics, diversity of indications for CS performed, as well as risk factors for SSI in different centers [1,3,4,9]. We included SSI within 3 days after surgery, only cases who presented in our hospital, missing SSI diagnosed and treated out of the hospital, and because of that we believed that the rate of SSI may be underestimated. In the present study, the majority of the isolates were obtained from patients who were already on routinely antimicrobial prophylaxis, and this could have reduced the pathogens identified.

SSI are the most common cause of prolonged hospital stay. The time period from CS to SSI is usually the third post surgical day, when a regular wound dressing is performed before the patient discharge. The average length of stay in our study was 7.02 days, compared to 4.2 days in study by Zejnullahu *et al*. [9] and 16.6 days in study by Jido *et al*. [10].

The role of prolonged rupture of the membrane as a predisposing factor for the development of SSI was confirmed in our study, as well [11,12]. The prevalence of Preterm rupture of membranes (PROM) in our study correlates with Devi *et al*. [13] study. Normally in pregnancy, foetal membranes serve as barriers to infection and make amniotic fluid sterile. However, when foetal membranes are ruptured, the amniotic fluid may act as a transport medium by which normal and pathological flora of the lower genital tract may come into contact with the uterine and skin incisions which cause infection [3,12,14,15]. For this reason, in addition to wound swabs, we also took lochia swabs from our patients.

During the postoperative period SSI is most commonly evaluated by monitoring the patient's white blood cell (WBC) count and C-reactive protein (CRP) levels [16,17]. Gram-positive and Gram-negative acute bacterial infections, cause CRP rises [16]. It is important to follow WBC and CRP evolution during hospitalization, because changes are very helpful in monitoring response to therapy [16,17]. C-reactive protein and white blood cells count at the time when swab was taken and at discharge from hospital was statistically significantly different in steril and non sterile swab groups.

Most commonly isolated bacteria from SSI after CS were Staphylococcus spp, *Enterococcus faecalis*, *Escherichia coli*, *Klebsiella spp*, *Proteus mirabilis*, *Pseudomonas spp*, *Enterobacter spp*, *Acinetobacter spp* and *Seratia marcescens*, which was confirmed by our study as well [2–4]. Above mentioned pathogenes are endogenous vaginal flora usually introduced following repeated vaginal examinations [2,13]. In our study we have high rate coincidences the same pathogen in wound and lochia swab, which explains the path of wound infection and the need to take swabs of wound and lochia when SSI is suspected. However, staphylococci are a dominant component of the patients and staff skin and nasal microbiome and the most common microorganisms responsible for causing SSI, which is not the case in our study [9,18]. In our study on the first place was *Enterococcus faecalis*, while *Staphylococcus aureus* was on the fourth place. Gram-negative pathogenes were the most common causes of SSI in our study and has been documented in many studies [19]. There were no isolated streptococci in our study. In our study, gram-negative infections were more common due to their occurrence in the hospital environment and related to the endogenous vaginal flora. Also because it is not screening vaginal swabs during pregnancy, but swabs when a wound infection has already developed after a cesarean section. Considering that the SSI after CS could be polymicrobial the samples should be ap-

Table 5. Results of antibiogram for gram-negative isolates found in wound and lochia swab.

Antibiotics susceptibility profile N (%)	*Escherichia coli*		*Klebsiella pneumoniae*		*Proteus mirabilis*		*Enterobacter species*		*Pseudomonas aeruginosa*		*Citrobacter koserii*		*Morganella morgani*	
	S	R	S	R	S	R	S	R	S	R	S	R	S	R
AMK	25 (96)	1 (4)	9 (100)	-	3 (100)	-	3 (100)	-	1 (100)	-	1 (100)	-	1 (100)	-
AMX	22 (84.6)	4 (15.3)	4 (44.4)	5 (55.5)	3 (100)	-	2 (66.6)	1 (33.3)	-	-	1 (100)	-	-	1 (100)
AMP	7 (27)	19 (73)	-	9 (100)	3 (100)	-	-	3 (100)	-	-	-	1 (100)	-	1 (100)
CEF	22 (84.6)	4 (15.3)	7 (77.7)	2 (22.2)	3 (100)	-	2 (66.6)	1 (33.3)	-	-	-	-	-	1 (100)
CEFE	25 (96)	1 (4)	9 (100)	-	3 (100)	-	3 (100)	-	1 (100)	-	1 (100)	-	1 (100)	-
CEFO	25 (96)	1 (4)	9 (100)	-	3 (100)	-	3 (100)	-	1 (100)	-	1 (100)	-	1 (100)	-
CEFT	25 (96)	1 (4)	9 (100)	-	3 (100)	-	3 (100)	-	-	-	1 (100)	-	1 (100)	-
CEFU	25 (96)	1 (4)	9 (100)	-	3 (100)	-	2 (66.6)	1 (33.3)	-	-	1 (100)	-	1 (100)	-
CIP	22 (84.6)	4 (15.3)	8 (88.8)	1 (11.1)	3 (100)	-	3 (100)	-	1 (100)	-	1 (100)	-	1 (100)	-
GEN	24 (92.3)	2 (7.7)	9 (100)	-	3 (100)	-	3 (100)	-	1 (100)	-	-	1(100)	1 (100)	-
IMI	26 (100)	-	9 (100)	-	3 (100)	-	3 (100)	-	1 (100)	-	1 (100)	-	-	-
LEV	23 (88.4)	3 (11.5)	9 (100)	-	3 (100)	-	3 (100)	-	1 (100)	-	1 (100)	-	1 (100)	-
MER	26 (100)	-	9 (100)	-	3 (100)	-	3 (100)	-	1 (100)	-	1 (100)	-	-	-
TOB	26 (100)	-	9 (100)	-	3 (100)	-	2 (66.6)	1 (33.3)	1 (100)	-	1 (100)	-	-	-
TR/S	19 (73)	7 (27)	9 (100)	-	3 (100)	-	3 (100)	-	1 (100)	-	1 (100)	-	1 (100)	-

S, sensitive; R, resistant; AMK, Amikacin; AMX, Amoxicilin/clavulanic acid; AMP, Ampiciline; CEF, Cefasolin; CEFE, Cefepim; CEFO, Cefotaxim; CEFT, Ceftazidim; CEFU, Cefuroxim; CIP, Ciprofloxacine; GEN, Gentamycine; IMI, Imipenem; LEV, Levofloxacin; MER, Meropenem; TOB, Tobramicin; TR/S, Trimetoprim/Sulfmetoxasol.

propriately processed for aerobic, anaerobic, gram positive and negative bacterias and fungi [2]. We found the similar prevalence of polymicrobial etiology of SSI after CS as De *et al*. [20] (7.7% vs 5.8%), respectively.

In our study we found 22% sterile swabs despite present a clinical signs of SSI, which is higher in compared to study by Zejnullahu *et al*. [9] 6.25% respectively. This differencies can be explained by more frequent use of prophylactic antibiotics in our study, whic may result in sterile swabs. Also, sterile swabs presumably may have represented anaerobic organisms, difficult to isolate in our setting. Primarily for technical reasons, storing the sample in the ward as well as the time from taking to transporting the sample.

In our study, S. aureus isolates were sensitive to fluoroquinolones, clindamycine and vancomycine, and resistant to peniciline, and moderately resistant to amikacine, gentamycine and eritromycine. These findings are in contrast with a previous study by Njoku *et al*. [3], which reported that S. aureus isolates were sensitive to amikacin and resistant to cephalosporins and gentamycine, and moderately resistant to fluoroquinolones.

The gram-negative isolates were highly sensitive to imipenem and amikacin; highly and moderate resistant to cephalosporins, gentamicin, beta-lactams and fluoroquinolones. In Makanjuola *et al*. [19] study observed that gram-negative isolates were highly sensitive to cephalosporins and fluoroquinolones. In Njoku *et al*. [3] study antibiotics sensitivity profile for gram-negative isolates correlates with our findings. High sensitivity to imipenem and amikacin may be due to the limited exposure of these drugs in the first line treatment of SSI. The high and moderate resistancy to a first-line antimicrobial agent like beta-lactams, gentamycin and cephalosporins observed in our study may be as a result of use and abuse of these drugs in our environment [3].

Bacterial resistance mechanisms may contribute to avoid the effect of prophylactically prescribed antibiotics [2]. It is important to understand the local antibiotic susceptibility profile to prescribe adequate antibiotic therapy, while awaiting the result of wound swab microscopy, culture and sensitivity to reduce the complications of SSI [2,3]. Because of improper antibiotic prophylaxis; prolonged use, error in the choice as well as dosing of the antibiotics may lead to microbial resistence and increase SSI rates [9,18]. Differences in our clinic regarding the antibiotic prophylaxis before and after CS, are mainly caused by the lack of adequate antenatal care in pregnant women, insufficient screening for bacterial infections of lower genital tract in pregnancy and low socioeconomic status of the patients [9,21].

Further, the type of surgical skin preparation may also be important in an attempt to reduce SSI. Studies found that chlorhexidine gluconate in combination with povidon iodine was associated with lower rates of bacterial growth and reduces wound infection rates when compared to iodine alone [7,8].

Limitations of our study were that we included only SSI diagnosed during the inpatient stay and superficial SSI, meaning that we not included cases who were diagnosed and treated out of hospital, which may falsely lower the overall obtained rate of SSI. Another limitation is that we not included some risk factors for SSI, but this could be subject of our next research. Strength of our study is that our institution is a tertiary center with a large influx of patients and deliveries.

5. Conclusions

In conclusion the prevalence of SSI following cesarean section was high and *Enterococccus faecalis and Escherichia coli* was the commonest pathogens isolated. Future research should focus on identifying women at risk for SSI during pregnancy and prevention strategies for risk groups of women.

Author contributions

GB and AC designed the research study. GB and AC performed the research. EC, DH, FN, AB, BM, AJČ and ŽM provided help and advice on the experiments. GB and AC analyzed the data. All authors have read and approved the final manuscript.

Ethics approval and consent to participate

Every patients gave informed consent to participate in the study. The protocol was approved by the Ethics Committee of the University Clinical Center Tuzla (approval number 02-09/2-61/20).

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Conflict of interest

The authors declare no conflict of interest. DH is serving as one of the Editorial Board of this journal. We declare that DH had no involvement in the peer review of this article and has no access to information regarding its peer review. Full responsibility for the editorial process for this article was delegated to PIC.

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