



2023

## Prevention of endometritis by precesarean section vaginal preparation using povidone–iodine versus chlorhexidine

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### Recommended Citation

Shahin, Abdlehamid E.; Elshamy, Elsayed; Dawood, Ragab M.; Hosary, Samar R.M. El; and Fathey, Amira A. (2023) "Prevention of endometritis by precesarean section vaginal preparation using povidone–iodine versus chlorhexidine," *Menoufia Medical Journal*: Vol. 36: Iss. 2, Article 26.

DOI: <https://doi.org/10.59204/2314-6788.1077>

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## ORIGINAL STUDY

# Prevention of Endometritis by Precesarean Section Vaginal Preparation Using Povidone–Iodine Versus Chlorhexidine

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### Abstract

**Objectives:** To compare the efficacy of povidone–iodine versus chlorhexidine in the prevention of postpartum endometritis and related febrile morbidity in women undergoing elective cesarean section (CS).

**Background:** Use of vaginal antiseptic preparation before CS reduced the risk of postoperative endometritis, and should preoperative vaginal with antiseptics be implement before CS.

**Patients and methods:** A randomized comparative observational study that was conducted on 110 patients at the Gynecology and Obstetrics Department of Menoufia University Hospital. Also, they were divided into group I which included 55 women, who were subjected to preoperative vaginal preparation with povidone–iodine and group II which included 55 women who were subjected to preoperative vaginal preparation with chlorhexidine. Full history, detailed examination, and primarily samples were taken during the period study from 2019 till 2021.

**Results:** There was no statistically significant difference between chlorhexidine and povidone–iodine groups regarding gestational age ( $P = 0.67$ ), BMI ( $P = 0.204$ ), systolic blood pressure ( $P = 0.903$ ), diastolic blood pressure ( $P = 0.75$ ), hypertension ( $P = 0.982$ ), duration of operation ( $P = 0.061$ ), hospital stay ( $P = 0.85$ ), endometritis ( $P = 0.072$ ), and wound infection ( $P = 0.591$ ). Postoperative fever was significantly increased among povidone–iodine group than the chlorhexidine group (20% vs. 2.58%, respectively,  $P = 0.013$ ).

**Conclusion:** Cesarean deliveries are complicated by maternal fever and wound complications including seroma, hematoma, and infection. Chlorhexidine seems to be more effective than povidone–iodine as a vaginal antiseptic preparation applied immediately before elective CS in the reduction of postpartum fever. Generally, providers should implement the simple preoperative vaginal preparation with antiseptics before cesarean deliveries.

**Keywords:** Cesarean section, Chlorhexidine, Endometritis, Povidone–iodine

## 1. Introduction

Cesarean section (CS) is currently one of the most common surgical procedures performed in concurrent obstetrics. Postoperative infectious morbidity is one of the main adverse sequelae in cesarean deliveries [1]. Endometritis can complicate cesarean delivery at a rate ranging between 6 and 27% [2]. In addition, cesarean deliveries are frequently complicated by maternal fever and

wound complications including seroma, hematoma, infection, and separation [3]. It has been found that most of the pathogenic organisms that are responsible for such postoperative infectious complications in CS colonize from the vagina. Prophylactic antibiotic has been a standard practice in CS and is shown to be effective in the prevention of postoperative endometritis and surgical site sepsis [4]. Nevertheless, despite the wide use of prophylactic antibiotics, postoperative sepsis remains a serious

Received 22 September 2022; revised 25 October 2022; accepted 3 November 2022.  
Available online 3 November 2023

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<https://doi.org/10.59204/2314-6788.1077>

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complication [1]. Vaginal antiseptic preparation using povidone–iodine has been a common practice before abdominal, vaginal hysterectomies and is shown to reduce the risk of postoperative sepsis [5]. Likewise, vaginal antiseptic preparation using povidone–iodine was used before CS procedures and was found to reduce the risk of postpartum endometritis [1]. Chlorhexidine is a broad-spectrum antiseptic that has been used extensively for many decades in hospital and other clinical settings. Chlorhexidine gluconate is shown to be more effective than povidone–iodine in decreasing the bacterial colony counts that are found in the operative field for vaginal hysterectomy [5]. The aim of the study was to compare the efficacy of povidone–iodine versus chlorhexidine in the prevention of postpartum endometritis and related febrile morbidity in women undergoing elective CSs.

## 2. Patients and methods

A randomized comparative observational study that was conducted on 110 patients at the Gynecology and Obstetrics Department of Menoufia University Hospital. Also, the patients were divided into group I which included 55 women who were subjected to preoperative vaginal preparation with povidone–iodine (Betadine 100 mg/ml roztwór na skórę 30 ml, polyvidonum iodatum) and group II included 55 women who were subjected to preoperative vaginal preparation with chlorhexidine (Peridex, chlorhexidine gluconate, 1 Galon, 3.735 L). Full detailed examination and primarily samples were taken during the period of study from 2019 till 2021. All procedures were carried out in accordance with the ethical standards of the institutional committee. The study received the approval from Hospital Local Medical Ethics Committee. The aim and steps of the study were explained to the participants, and written informed consent was obtained from all study participants after explaining the nature and scope of the study. Inclusion criteria included term pregnant women, who were admitted from causality for planned elective cesarean delivery. Exclusion criteria included obese women who have a prepregnancy BMI more than 30 kg/m<sup>2</sup>, women who are in labor, women who have ruptured fetal membranes, antepartum hemorrhage, women who were maintained on chronic steroid or immunosuppressive treatment, women who had intraoperative or postoperative events that independently may raise the risk of endometritis. All selected women included in this study were subjected to full history taking such as age, sex, occupation, gestational age, special habit,

parity, and hypertension. General examination included anthropometric measurements such as height, weight, and BMI. Vital signs such as pulse, blood pressure, and temperature. All women were subjected to investigation using the complete blood count by The Sysmex XN-450/XN-430, which is a quantitative automated hematology analyzer (Sysmex Corporation, Tokyo, Japan). CRP is measured by a CRP analyzer (Nycocard), and liver function test by CX9 Beckman Coulter autoanalyzers. All included women received preoperative prophylactic antibiotic [(1 g cephadrine intravenous (Velosef 1 g)] at the time of induction of anesthesia. The study outcome measures were primary outcomes, included wound site infection occurring within 14 days of caesarian delivery including superficial or deep surgical site infections, identified by the presence of erythema or occurrence of abdominal incision disruption with purulent discharge, and secondary outcomes was development of postoperative fever defined as any temperature 38 °C 24 hours postoperatively. Development of postpartum endometritis defined as fever 38 °C, uterine tenderness, and offensive vaginal discharge that necessitates antibiotic treatment and development of SSI. After exclusion of other causes of fever etc. UTI, chest infection by clinical, laboratory and radiological investigation. Sample size was calculated using PASS 11.0 and based on past review of literature by Bellows et al. [6], who estimated the incidence of postpartum endometritis complications in 2–16% of women who underwent cesarean delivery. Sample size was calculated using the following equation:  $n = (X^2 \times P \times Q) / D^2$  at CT 95%. Assuming 0.05 (standard value of 1.96), we would need 110 pregnant women delivered by elective CS to achieve a power of 80%. Results were collected, tabulated, and statistically analyzed by IBM personal computer and statistical package SPSS, version 20 (2013; IBM Corp., Armonk, New York, USA). Descriptive statistics included percentage (%), mean, and SD; and analytic statistics included Student's *t* test,  $\chi^2$  test, and Mann–Whitney test (*U*). *P* value less than 0.05 was considered statistically significant.

## 3. Results

The mean of age, gestational age, and BMI of the included patients were 28.13 ± 4.26 years 38.4 ± 2.15 weeks, and 26.02 ± 5.12 kg/m<sup>2</sup>, respectively. Diabetes mellitus was reported in 9.09% of the included patients while 10% of them had hypertension. Also, mean systolic and diastolic blood pressure of the studied patients were 109 ± 7.16 and 70.03 ± 5.78, respectively. Previous, Breech and CPD indication of CS were reported in 58.18, 30, and 20% of the studied

patients, respectively (Table 1). The mean of CRP, MCV, Hb, RBCs, WBCs, platelets, HCT, MCH, and MCHC were  $8.68 \pm 2.26$ ,  $84.61 \pm 29.39$ ,  $11.13 \pm 4.23$ ,  $3.82 \pm 0.99$ ,  $8.8 \pm 3.91$ ,  $225.59 \pm 23.03$ ,  $33.49 \pm 9.64$ ,  $27.74 \pm 5.25$ , and  $31.80 \pm 11.74$ , respectively. Mean ALT, AST, RBG, lymphocytes, PT, INR, neutrophil, monocytes, and eosinophils were  $21.80 \pm 2.78$ ,  $36.06 \pm 5.58$ ,  $68.65 \pm 4.47$ ,  $24.19 \pm 9.65$ ,  $13.29 \pm 3.09$ ,  $1.11 \pm 0.44$ ,  $66.96 \pm 11.06$ ,  $5.32 \pm 1.96$ , and  $1.97 \pm 0.69$ , respectively (Table 2). There were no significant differences between chlorhexidine and povidone–iodine groups regarding age, gestational age, BMI, systolic blood pressure, diastolic blood pressure, diabetes mellitus, and hypertension (Table 3). There were no significant differences between chlorhexidine and povidone–iodine groups regarding CRP, MCV, Hb, RBCS, WBCs, HCT, MCH, MCHC, ALT, AST, PT, INR, neutrophil, monocytes, and eosinophils ( $P > 0.05$ ) while there were significant differences between the studied groups

Table 1. Demographic and clinical data of the studied women

Items	The studied women (N = 110)
Age (years)	
Mean $\pm$ SD	28.13 $\pm$ 4.26
Range	21.0–35.0
Gestational age (weeks)	
Mean $\pm$ SD	38.4 $\pm$ 2.15
Range	37–41
BMI (kg/m <sup>2</sup> )	
Mean $\pm$ SD	26.02 $\pm$ 5.12
Range	22.0–32.0
Parity (1–4)	n (%)
Primary CS	43 (39.09)
Repeated CS	67 (60.91)
History of diseases	
Hypertension	
Yes	11 (10.00)
No	99 (90)
Diabetics	
Yes	10 (9.09)
No	100 (90.91)
Blood pressure	
Systolic	
Mean $\pm$ SD	109 $\pm$ 7.16
Diastolic	
Mean $\pm$ SD	70.03 $\pm$ 5.78
Indication of CS	
Previous	
Yes	40 (59.70)
No	27 (24.55)
Breech	
Yes	33 (30)
No	77 (70)
CPD	
Yes	22 (20)
No	88 (80)

CPD, cephalopelvic disproportion; CS, cesarean section.

Table 2. Laboratory investigations for the studied women

Laboratory investigations	The studied women (N = 110)
CRP	
Mean $\pm$ SD	8.68 $\pm$ 2.26
MCV	
Mean $\pm$ SD	84.61 $\pm$ 29.39
Hb	
Mean $\pm$ SD	11.13 $\pm$ 1.23
RBCs	
Mean $\pm$ SD	3.82 $\pm$ 0.99
WBCs $\times 10^3$	
Mean $\pm$ SD	8.8 $\pm$ 3.91
Platelets	
Mean $\pm$ SD	225.59 $\pm$ 23.03
HCT	
Mean $\pm$ SD	33.49 $\pm$ 9.64
MCH	
Mean $\pm$ SD	27.74 $\pm$ 5.25
MCHC	
Mean $\pm$ SD	31.80 $\pm$ 11.74
ALT	
Mean $\pm$ SD	21.80 $\pm$ 2.78
AST	
Mean $\pm$ SD	36.06 $\pm$ 5.58
RBG	
Mean $\pm$ SD	68.65 $\pm$ 4.47
Lymphocytes	
Mean $\pm$ SD	24.19 $\pm$ 9.65
PT	
Mean $\pm$ SD	13.29 $\pm$ 3.09
INR	
Mean $\pm$ SD	1.11 $\pm$ 0.44
Neutrophil	
Mean $\pm$ SD	66.96 $\pm$ 11.06
Monocytes	
Mean $\pm$ SD	5.32 $\pm$ 1.96
Eosinophils	
Mean $\pm$ SD	1.97 $\pm$ 0.69

ALT, alanine transaminase; AST, aspartate aminotransferase; Hb, hemoglobin; MCH, mean corpuscular hemoglobin; MCV, mean corpuscular volume; PLT, platelet; RBS, random blood sugar; RDW, red cell distribution width; WBCs, white blood cells.

regarding platelet, RBG, and lymphocytes ( $P < 0.05$ ) (Table 4). Postoperative fever was significantly increased among the povidone–iodine group than the chlorhexidine group (20% vs. 2.58%, respectively,  $P = 0.013$ ) while, there were no significant differences between chlorhexidine and povidone–iodine groups regarding body weight, duration of operation, hospital stay, endometritis, and wound infection ( $P > 0.05$ ) (Table 5).

#### 4. Discussion

CS is currently one of the most common surgical procedures performed in concurrent obstetrics. Postoperative infectious morbidity is one of the main adverse sequelae in cesarean deliveries [1]. Endometritis can complicate cesarean delivery at a

Table 3. Comparison between chlorhexidine and povidone–iodine groups regarding demographic data and disease history

	The studied groups (N = 110)		t test	P value
	Chlorhexidine group (N = 55)	Povidone–iodine group (N = 55)		
Age (years)				
Mean ± SD	26.25 ± 9.05	30.0 ± 7.11		
Range	21.00–35.00	28.00–32.00	1.04	0.67
Gestational age (weeks)				
Mean ± SD	37.87 ± 2.34	38.52 ± 2.16	U = 0.251	0.188
Range	37–39	37–41		
BMI (kg/m <sup>2</sup> )				
Mean ± SD	26.11 ± 7.67	25.92 ± 3.12	0.398	0.204
Range	25–32	22–32		
Blood pressure				
Systolic				
Mean ± SD	108 ± 6.11	110 ± 8.20	U = 0.115	0.903
Range	100–120	100–120		
Diastolic				
Mean ± SD	70.05 ± 2.40	70.00 ± 9.15	U = 0.220	0.750
Range	60–80	65–80		
	n (%)	n (%)	χ <sup>2</sup>	P value
Hypertension				
Yes	4 (7.27)	7 (12.73)	0.04	0.982
No	51 (92.73)	48 (87.27)		
Diabetics				
Yes	6 (10.91)	4 (7.27)	1.33	0.204
No	49 (89.09)	51 (92.73)		

t, independent test; U, Mann–Whitney test; c<sup>2</sup>, c<sup>2</sup> test.

rate ranging between 6 and 27% [2]. Moreover, cesarean deliveries are frequently complicated by maternal fever and wound complications including seroma, hematoma, infection and separation [3]. Chlorhexidine is a broad-spectrum antiseptic that has been used extensively for many decades in hospital and other clinical settings [7]. The role of iodine in wound care is primarily as an antimicrobial agent. Povidone–iodine has been used and tested in wound healing for many decades [8]. So, this study aimed to compare the efficacy of povidone–iodine versus chlorhexidine in the prevention of postpartum endometritis and related febrile morbidity in women undergoing elective CS.

In this study, the mean of age, gestational age, and BMI of patients were 28.13 ± 4.26 years, 38.4 ± 2.15 weeks, and 26.02 ± 5.12 kg/m<sup>2</sup>, respectively. Also, 47.27% of the included patients had P2 parity. Diabetes mellitus was reported in 9.09% of the included patients while 10% of them had hypertension. Also, systolic and diastolic blood pressure were 109 ± 7.16 and 70.03 ± 5.78, respectively. This agreed with Mohammad et al. [9] who found the mean age of the included patients was 26.4 ± 5.1 years with a mean number of previous CS of 1 ± 1 and had one parity. Our results were consistent with Akl et al. [10] who found the mean age of the studied patients was 26.12 ± 2.88 years; the mean BMI was 28.98 ± 1.15 kg/m<sup>2</sup>; and the mean gestational age

was 38.49 ± 0.70 weeks. Another study by Stone et al. [11] found that the mean age, gestational age, and BMI of the included patients were 35.1 ± 5.0 years, 38.7 ± 1.2 15 weeks and 30.1 ± 5.9 kg/m<sup>2</sup>, respectively. Diabetes mellitus was reported in 3.25% of the included patients while 8.5% of them had hypertension.

In the current study, mean CRP, MCV, Hb, RBCs, WBCs, platelets, HCT, MCH, and MCHC were 8.68 ± 2.26, 84.61 ± 29.39, 11.13 ± 4.23, 3.82 ± 0.99, 8.8 ± 3.91, 225.59 ± 23.03, 33.49 ± 9.64, 27.74 ± 5.25, and 31.80 ± 11.74, respectively. Mean ALT, AST, RBG, lymphocytes, PT, INR, neutrophil, monocytes, and eosinophils were 21.80 ± 2.78, 36.06 ± 5.58, 68.65 ± 4.47, 24.19 ± 9.65, 13.29 ± 3.09, 1.11 ± 0.44, 66.96 ± 11.06, 5.32 ± 1.96, and 1.97 ± 0.69, respectively. Our findings were similar to Mohammad et al. [9], who found the mean HB level of the studied patients was 11.72 ± 0.56, while the mean platelet in the studied patients was 262 ± 51.167. Also, the mean WBC count was 6.94 ± 0.88. This also agrees with Sahu et al. [12], the mean preoperative HB level was 11.4 ± 1.46, while the postoperative level was 11.6 ± 1.38.

In the current study, there were no significant differences between chlorhexidine and povidone–iodine groups regarding CRP, MCV, Hb, RBCs, WBCs, HCT, MCH, MCHC, blood pressure, diabetes mellitus, and hypertension. However, a

Table 4. Comparison between chlorhexidine and povidone–iodine groups regarding laboratory investigation

	The studied groups (N = 110)		t test	P value
	Chlorhexidine group (N = 55)	Povidone–iodine group (N = 55)		
CRP				
Mean ± SD	8.24 ± 2.66	9.12 ± 1.85	1.33	0.270
MCV				
Mean ± SD	85.56 ± 31.67	83.66 ± 27.11	0.076	0.871
Hb%				
Mean ± SD	11.01 ± 4.80	11.25 ± 3.66	U = 0.162	0.920
RBCs				
Mean ± SD	3.92 ± 1.05	3.71 ± 0.92	1.09	0.304
WBCs × 10 <sup>3</sup>				
Mean ± SD	8.53 ± 3.25	9.07 ± 4.57	U = 0.520	0.603
Platelet				
Mean ± SD	210.5 ± 38.20	240.67 ± 7.85	3.25	0.040 <sup>a</sup>
HCT				
Mean ± SD	33.49 ± 7.13	33.50 ± 12.15	0.002	0.912
MCH				
Mean ± SD	28.12 ± 6.25	27.35 ± 4.25	0.810	0.145
MCHC				
Mean ± SD	33.02 ± 12.8	30.57 ± 10.67	1.22	0.311
ALT				
Mean ± SD	21.09 ± 3.20	22.5 ± 2.36	0.130	0.742
AST				
Mean ± SD	37.00 ± 3.88	35.12 ± 7.28	2.150	0.566
RBG				
Mean ± SD	95.00 ± 3.67	42.30 ± 5.27	5.81	0.026 <sup>a</sup>
Lymphocytes				
Mean ± SD	26.92 ± 11.17	21.45 ± 8.13	3.25	0.033 <sup>a</sup>
PT				
Mean ± SD	12.8 ± 2.16	13.77 ± 4.01	U = 1.29	0.080
INR				
Mean ± SD	1.02 ± 0.54	1.20 ± 0.34	U = 0.012	0.760
Neutrophil				
Mean ± SD	65.58 ± 6.88	68.33 ± 15.23	2.04	0.061
Monocytes				
Mean ± SD	5.42 ± 1.75	5.22 ± 2.17	0.005	0.977
Eosinophils				
Mean ± SD	2.08 ± 0.43	1.85 ± 0.95	1.12	0.110

ALT, alanine transaminase; AST, aspartate aminotransferase; Hb, hemoglobin; MCH, mean corpuscular hemoglobin; MCV, mean corpuscular volume; PLT, platelet; RBS, random blood sugar; RDW, red cell distribution width; *t*, independent test; *U*, Mann–Whitney test; WBCs, white blood cells.

<sup>a</sup> Significant.

significant difference was found regarding platelet. This agrees with Lakhi et al. [13], who found both arms were comparable regarding age, parity, BMI, and gestational age at delivery. Similarly, no differences were found among comorbidities including diabetes, preeclampsia, and hypertension among randomization groups. Another study by Tewfik et al. [14] found no significant difference between povidone–iodine and chlorhexidine groups regarding mean age (27.12 ± 5.2 vs. 28.88 ± 5.9 years, respectively), mean BMI (21.81 ± 4.2 vs. 22.1 ± 5.1, respectively), and median parity (1 vs. 1, respectively). In the same line, Elshamy et al. [15] found no significant difference was observed in mean age, blood pressure, BMI, gestational age at delivery between the two groups. Moreover, nonsignificant

difference was found when other maternal characteristics such as parity, previous CS, comorbidities, and preeclampsia between two groups. In addition, Mohammed et al. [9] found no statistically significant difference in clinical examination as regards BP, temperature, and gestational age. However, Mohammed et al. [9] found a statistically significant difference between both groups as regards WBCs, HB, and platelets.

In the present study, there were no significant differences between chlorhexidine and povidone–iodine groups regarding abdominal pain and vaginal discharge. However, a statistically significant difference was recorded regarding fever. This is consistent with Roeckner et al. [7] who found that chlorhexidine vaginal preparation did not

Table 5. Comparison between chlorhexidine and povidone–iodine groups regarding neonatal outcomes and postoperative fever

	The studied groups (N = 110)		t test	P value
	Chlorhexidine group (N = 55)	Povidone–iodine group (N = 55)		
Body weight (kg)				
Mean ± SD	3.4 ± 0.81	3.1 ± 0.76	1.46	0.53
Range	2.5–3.5	2.5–3.4		
Duration of operation (min)				
Mean ± SD	34 ± 8.35	37.10 ± 12.51	U = 2.31	0.061
Range	30–45	30–42		
Hospital stay (h)				
Mean ± SD	17.03 ± 6.25	17.64 ± 12.10	0.029	0.85
Range	12–24	12–24		
	n (%)	n (%)	$\chi^2$	P value
Endometritis	3 (5.45)	6 (10.91)	2.014	0.072
Postoperative fever	4 (7.20)	11 (20.00)	5.67	0.013 <sup>a</sup>
Wound infection	1 (1.81)	2 (3.64)	0.078	0.591

t, independent test; U, Mann–Whitney test;  $\chi^2$ ,  $\chi^2$  test.

<sup>a</sup> Significant.

significantly reduce the risk of endometritis. Single trials that used metronidazole gel and cetrimeid each found a significant reduction in endometritis povidone–iodine 1% had a 72.7% chance of being the best treatment. Postoperative fever found a significant reduction with the 12 trials of povidone–iodine; vaginal preparations that used the chlorhexidine agent was not effective in reducing wound infection. This agreed with Lakhi et al. [13], who found that the rates of postcesarean endometritis and hospital readmission were similar in the povidone–iodine and chlorhexidine arms. In addition, Guzman et al. [16] found no differences in the incidence of chorioamnionitis or postpartum endometritis. No side-effects from the use of chlorhexidine were observed among women in the two groups. There was no significant difference between both groups regarding wound infection at 2 weeks after birth, although the chlorhexidine group had significantly reduced bacterial growth at 18 hours after a CS. On the other hand, Lakhi et al. [13] found the predetermined primary outcome, occurrence of wound infection, was significantly higher in the povidone–iodine arm as compared with the chlorhexidine arm. Also, this study disagreed with the present study that indicted no significant difference regarding postoperative fever. Roeckner et al. [7] found that povidone–iodine significantly reduced the risk of endometritis. Women who received vaginal cleansing with povidone–iodine at various concentrations had a significant reduction in the rate of wound infection.

In the current study, there were no significant differences between chlorhexidine and povidone–iodine groups, regarding body weight, duration of operation, and hospital stay. This agreed

with Marzouk et al. [17] who found that the mean length of hospital stay was almost similar (2.0 vs. 2.1 days), respectively, in the studied groups, with no statistically significant difference. Also, there were no significant differences between both groups concerning birth weight, indication, and duration of operation, which indicates that both groups were matched and homogeneous. Also, Taha et al. [18], Bakr and Karkour [19] found no significant difference between duration of hospital stays between both groups. Vaginal disinfection before delivery using 0.25% chlorhexidine results in a significant reduction of hospital stay between the study groups in two earlier studies. The nonrandomization of the study participants in both Egyptian and Malawi studies may explain the disagreement between both studies and current study findings. The study by Guzman et al. [16] found no significant difference between groups for preterm birth, low birth weight, or mean birth weight. On the other hand, they found the mean duration of hospital stay was reduced in the shorter arm of treatment compared with the longer arm.

In the present study, postoperative fever was significantly increased among the povidone–iodine group than the chlorhexidine group. The study by Tewfik et al. [14] similar to this study revealed a significantly higher rate of postoperative fever in povidone–iodine than the chlorhexidine group (13 cases, 28.3% vs. four cases, 8.5%, respectively). The rates of endometritis and wound infection were higher in povidone–iodine than the chlorhexidine group. Use of chlorhexidine rather than povidone–iodine was significantly associated with a threefold reduction in the risk of postoperative fever and twofold reduction in the risks of endometritis

and wound infection [14]. Also, the study by Chaiyakunapruk et al. [20] found no significant difference in the incidence of postoperative fever between the povidone–iodine group and the chlorhexidine group. The study by Hass et al. [1] concluded that vaginal preparation with povidone–iodine solution immediately before cesarean delivery reduces the risk of postoperative endometritis. Taken together, these data support the recommendation to use prophylactic antibiotics for all women undergoing a CS.

#### 4.1. Limitations

The major limitation of this study is the relatively small number of patients. Also, as it is a single-center study, it can limit its generalizability of the result to the population in the area.

#### 4.2. Conclusion

Cesarean deliveries complicated by maternal fever and wound complications including seroma, hematoma, and infection. Chlorhexidine seems to be more effective than povidone–iodine as a vaginal antiseptic preparation applied immediately before elective CS in reducing postpartum fever. Also, postoperative fever was significantly increased among the povidone–iodine group than the chlorhexidine group. However, no significant differences were obtained among the studied groups regarding endometritis and wound infection. So, we recommend to study on a large sample size, which is needed to confirm the effectiveness of this biomarkers. It makes a broad spectrum of results to ensure that chlorhexidine and povidone–iodine were used in the prevention of postpartum endometritis.

#### Financial-support and sponsorship

Nil.

#### Conflicts of interest

There are no conflicts of interest.

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