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Original Research Article

Effect of vaginal preparation before caesarean section on post operative infectious morbidity

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ABSTRACT

Background: Caesarean section (CS) is a common surgical procedure associated with postoperative infectious morbidities such as endometritis, wound infection, and urinary tract infection. Vaginal antiseptic preparation before CS has been proposed to reduce these complications by lowering bacterial load. This study aimed to evaluate the effect of vaginal preparation before CS on postoperative infectious morbidity.

Methods: This prospective study involved pregnant women undergoing caesarean delivery. Participants were divided into two groups: one undergoing vaginal cleansing with antiseptic solutions (povidone-iodine or chlorhexidine) before surgery, and the other receiving no vaginal preparation. Postoperative outcomes, including the incidence of endometritis, wound infections, urinary tract infections, and febrile morbidity, were recorded and compared between groups.

Results: Vaginal preparation significantly reduced the incidence of postoperative infections. A notable decrease in endometritis rates was observed among women who received preoperative vaginal cleansing, especially in cases of labor or ruptured membranes. Similarly, wound infection rates and urinary tract infections were lower in the intervention group. No serious adverse reactions related to antiseptic use were reported. Both povidone-iodine and chlorhexidine proved effective, with slight advantages seen for chlorhexidine in reducing overall morbidity due to its longer antimicrobial action and lower mucosal irritation.

Conclusions: Preoperative vaginal cleansing with antiseptics before caesarean delivery effectively reduces postoperative infectious morbidity, particularly endometritis. This simple, low-cost intervention is especially beneficial for high-risk cases, such as emergency CS s and cases with ruptured membranes. Routine adoption of vaginal preparation could enhance maternal outcomes and reduce healthcare burden.

Keywords: Caesarean section, Vaginal preparation, Postoperative infections, Endometritis, Povidone-iodine, Chlorhexidine

INTRODUCTION

Caesarean section is a surgical procedure involving delivery of the foetus through an abdominal incision (laparotomy) and a uterine incision (hysterotomy). The first recorded caesarean section was performed in 1020 AD, and the technique has since undergone major advancements.¹ It is now the most commonly performed surgical procedure in the United States, with over one million cases annually; the rate increased from 5% in 1970 to 31.9% in 2016.² Despite efforts to reduce its frequency,

experts predict no substantial decline in the near future.³ Although associated with both immediate and long-term complications, caesarean delivery remains the safest or only option for certain women. During the procedure, the surgeon sequentially incises the skin, subcutaneous tissue, fascia, and peritoneum to expose and open the uterus for foetal delivery.⁴ Before surgery, vaginal antiseptic cleansing—commonly referred to as vaginal preparation—is often performed to reduce the risk of postoperative infections such as endometritis by decreasing the bacterial load that may enter the uterine cavity. This involves

cleansing the vagina with an antiseptic solution such as chlorhexidine or povidone-iodine using a sterile swab shortly before incision.⁵ Povidone-iodine, typically diluted to 5-10%, releases iodine with broad-spectrum antimicrobial activity against bacteria, viruses, and fungi, and is widely used due to its efficacy, safety, and affordability.⁶ However, in iodine-allergic patients, chlorhexidine gluconate serves as an effective alternative with prolonged antimicrobial activity and reduced susceptibility to organic matter.⁷ Postoperative infections, including endometritis, wound infections, urinary tract infections, and pelvic abscesses, remain major contributors to maternal morbidity following caesarean section. These infections present with symptoms such as fever, uterine tenderness, and abnormal discharge, and are influenced by risk factors like prolonged labour, ruptured membranes, obesity, and diabetes.⁸ Proper antiseptic cleansing of both the skin and vagina significantly reduces bacterial contamination at the surgical site, thereby lowering postoperative infection rates and improving maternal outcomes.⁹ Given that vaginal preparation is a simple, cost-effective, and easily implementable measure to reduce infectious morbidity, especially in high-risk and emergency caesarean cases, it holds great clinical significance. Therefore, this study aims to evaluate the effect of vaginal preparation before caesarean section on postoperative infectious morbidity, comparing the efficacy of povidone-iodine and chlorhexidine in minimizing infection rates and improving maternal health outcomes.

METHODS

This prospective observational comparative study was conducted in the Department of Obstetrics and Gynaecology, Sarojini Naidu Medical College, Agra, from March 2023 to February 2024. The study included 486 pregnant women at term gestation who were scheduled for either elective or emergency caesarean sections. Participants were randomly divided into three groups based on the type of vaginal preparation before surgery, with 162 women in each group. Women undergoing caesarean section who provided informed consent were included. Those with systemic illnesses such as diabetes, heart or renal disease, severe anaemia, immunocompromised status, preoperative infections, prolonged rupture of membranes over eighteen hours, postpartum haemorrhage, prolonged surgery exceeding three hours, or prior antibiotic use were excluded. Ethical clearance was obtained from the Institutional Human Ethics Committee, and written informed consent was taken from all participants after explaining the study's purpose and potential risks. Confidentiality and voluntary participation were ensured. After recruitment and clinical evaluation, participants were assigned to three groups. Group I received vaginal cleansing with 10% povidone-iodine before lower segment caesarean section (LSCS), Group II received 4% chlorhexidine gluconate, and Group III had no vaginal preparation. All patients received a single dose of cefazolin 2 g within thirty minutes prior to surgery. Postoperatively, patients were observed for signs

of infection, including fever, vaginal or wound discharge, abdominal pain, swelling, or urinary symptoms. If symptoms occurred, relevant investigations such as complete blood count, malaria and dengue screening, urine culture, and pus culture (if wound infection was present) were performed using standard techniques. Follow-up was done on the tenth postoperative day to identify any late complications. Primary outcomes included postoperative endometritis, fever, wound infection, and urinary tract infection. Secondary outcomes included side effects of vaginal preparation and the organisms responsible for infections. The efficacy of povidone-iodine and chlorhexidine in preventing postoperative infections was compared among groups. Validity and reliability were ensured through standardized procedures, defined diagnostic criteria, and uniform antibiotic use. Data on demographic, clinical, and postoperative parameters were systematically recorded, and biological samples were collected when infection was suspected to assess infectious morbidity among the participants.

Statistical analysis

Statistical analysis was performed using SPSS software (SPSS Inc., Chicago, IL, USA) for the Windows program (26.0 version). The continuous variables were evaluated by mean (standard deviation) or range value when required. The dichotomous variables were presented in number/frequency and were analysed using the Chi-square test. To compare the means between the two or more groups, analysis by ANOVA test was used. A $p < 0.05$ or 0.001 was regarded as significant.

RESULTS

The mean age of participants was comparable among the three groups, with Group-P showing 29.45 ± 8.22 years, Group-C 28.16 ± 7.82 years, and Group-N 28.77 ± 8.52 years ($F = 8.951$, $p = 0.289$). Most women were aged 25-30 years across all groups, and the categorical age distribution showed no significant difference. Parity distribution was also similar and no statistical difference observed. However, the mean gestational age differed significantly ($p = 0.004$), being slightly higher in Group-C (Table 1). The indications for caesarean section were comparable, with foetal distress being the most common (27.8%, 29.6%, and 30.9% in Groups P, C, and N respectively), followed by previous LSCS (34.0%, 32.7%, and 32.1%). No significant difference was observed ($\chi^2 = 0.684$, $p = 0.995$) (Figure 1). The mean duration of labour was 6.15 ± 2.42 , 5.87 ± 2.14 , and 6.58 ± 2.58 hours in Groups P, C, and N respectively ($F = 2.570$, $p = 0.078$), showing no statistical significance. The majority of participants in all groups had a labour duration between 4-8 hours (58.6% in Group-P, 58.0% in Group-C, and 59.9% in Group-N). (Figure 2). Cervical dilation was also similar, with mean values of 5.64 ± 1.88 cm in Group-P, 5.37 ± 1.62 cm in Group-C, and 6.03 ± 1.96 cm in Group-N ($F = 3.502$, $p = 0.478$) (Figure 3). Ruptured membranes were noted in 17.9%, 14.81%, and 19.14% of participants in Groups P, C, and N respectively (Table 2).

Elective caesarean sections accounted for 54.94%, 58.02%, and 51.85% in Groups P, C, and N respectively ($p=0.536$) (Figure 4). Infectious morbidities were comparable, with endocervical colonization in 5.56%, 4.32%, and 10.49%; fever in 5.56%, 3.70%, and 12.9%; and endometritis only in Group-N (1.23%) ($p=0.661$) (Table 3). Surgical site infections were similar across

groups ($p=0.999$) (Table 4). The mean hospital stay differed significantly, being 5.86 ± 1.23 days in Group-P, 4.77 ± 0.92 in Group-C, and 6.54 ± 1.47 in Group-N ($F=94.187$, $p=0.0001$) (Table 5). *E. coli* was the most common UTI pathogen, isolated in 80.95% of cases, followed by *Pseudomonas* species in the 19.05% (Figure 5).

Table 1: Demographic and obstetric characteristics of study participants.

Parameters	Group P, (n=162)	Group C, (n=162)	Group N, (n=162)	P value
Age (in year)				
Mean±SD	29.45±8.22	28.16±7.82	28.77±8.52	F=8.951 p=0.289
<25	40 (24.7%)	35 (21.6%)	45 (27.8%)	F=3.027 p=0.805
25-30	60 (37.0%)	65 (40.1%)	55 (34.0%)	
31-35	42 (25.9%)	45 (27.8%)	40 (24.7%)	
>35	20 (12.4%)	17 (10.5%)	22 (13.6%)	
Parity				
Primigravida (First pregnancy)	50 (30.9%)	55 (34.0%)	48 (29.6%)	X=1.031 p=0.905
Multiparous (2-3 pregnancies)	80 (49.4%)	78 (48.1%)	85 (52.5%)	
Grand multipara (>3 pregnancies)	32 (19.8%)	29 (17.9%)	29 (17.9%)	
Gestational age (in weeks)	38.96±1.52	39.12±1.35	38.77±1.63	F=5.483 p=0.004

Table 2: Membrane status and rupture interval in study participants based on vaginal preparation before CS.

Membrane status	Group P	Group C	Group N	P value
Ruptured	29 (17.90%)	24 (14.81%)	31 (19.14%)	X=1.123, p=0.570
Intact	133 (82.10%)	138 (85.19%)	131 (80.86%)	
Mean $\pm$ SD	4.23 $\pm$ 1.76	3.93 $\pm$ 1.58	4.56 $\pm$ 1.87	F=3.424, p=0.033
Rupture interval	<3 hours	8 (33.33%)	8 (27.59%)	X=2.235, p=0.693
	3-6 hours	10 (32.26%)	12 (41.38%)	
	>6 hours	12 (38.71%)	9 (31.03%)	

Table 3: Infection morbidities among study participants.

Infection morbidity	Group P	Group C	Group N	P value
Endocervical colonization	9 (5.56%)	7 (4.32%)	17 (10.49%)	X=4.119, p=0.661
Fever	9 (5.56%)	6 (3.70%)	21 (12.9%)	
Endometritis	0 (0.00%)	0 (0.00%)	2 (1.23%)	
UTI	4 (2.47%)	7 (4.32%)	10 (6.17%)	

Table 4: Surgical site infections among study participants.

Surgical site infection	Group P	Group C	Group N	P value
Abdominal tenderness	7 (4.32%)	6 (3.70%)	12 (7.41%)	X=0.854 p=0.999
Foul-smelling vaginal discharge	8 (4.94%)	7 (4.32%)	14 (8.64%)	
Wound discharge	8 (4.94%)	7 (4.32%)	11 (6.79%)	
Erythema/edema	4 (2.47%)	3 (1.85%)	9 (5.56%)	
Wound breakdown	3 (1.85%)	3 (1.85%)	6 (3.70%)	

Table 5: Postoperative outcomes based on vaginal preparation before CS.

Parameters	Group P	Group C	Group N	P value
Duration of hospital stay (days)	5.86 $\pm$ 1.23	4.77 $\pm$ 0.92	6.54 $\pm$ 1.47	F=94.187, p=0.0001
≤ 5	48 (29.6%)	103 (63.6%)	27 (16.7%)	X=76.672, p=0.0001
6-7	87 (53.7%)	55 (34.0%)	91 (56.2%)	
>7	27 (16.7%)	4 (2.4%)	44 (27.1%)	

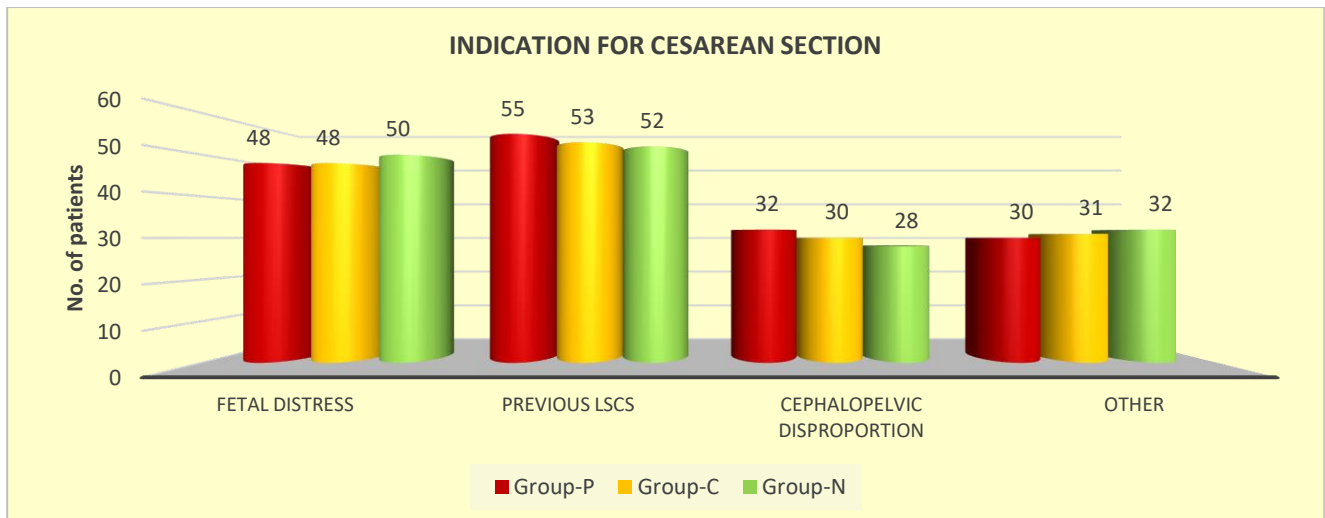


Figure 1: Indications for CS among study participants.

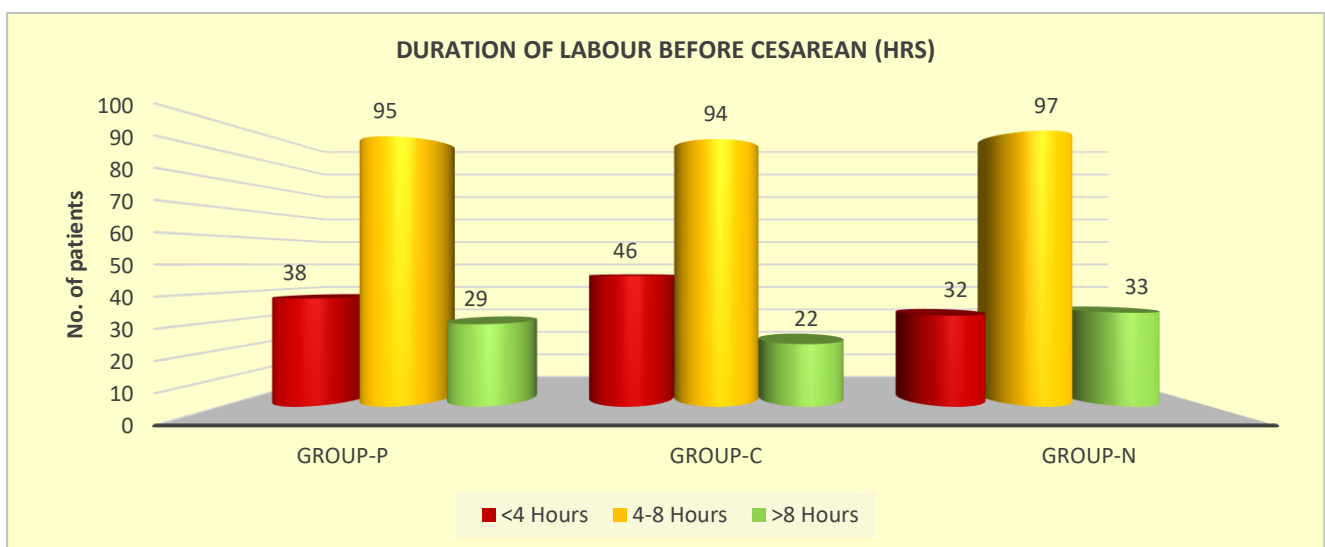


Figure 2: Duration of labour prior to CS.

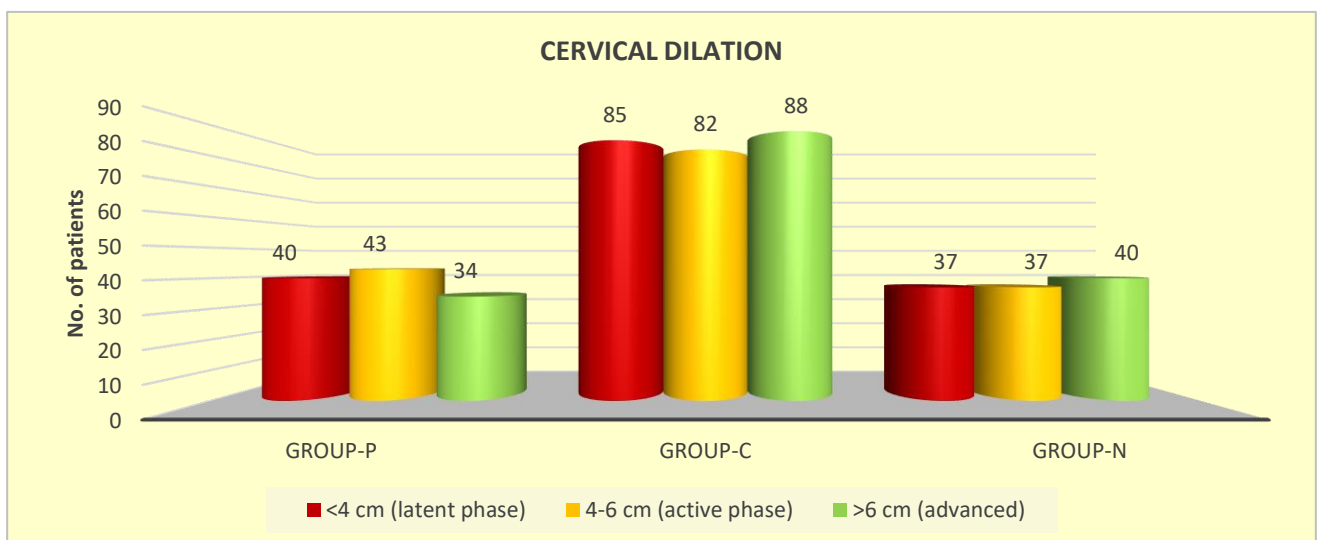


Figure 3: Cervical dilatation at the time of CS.

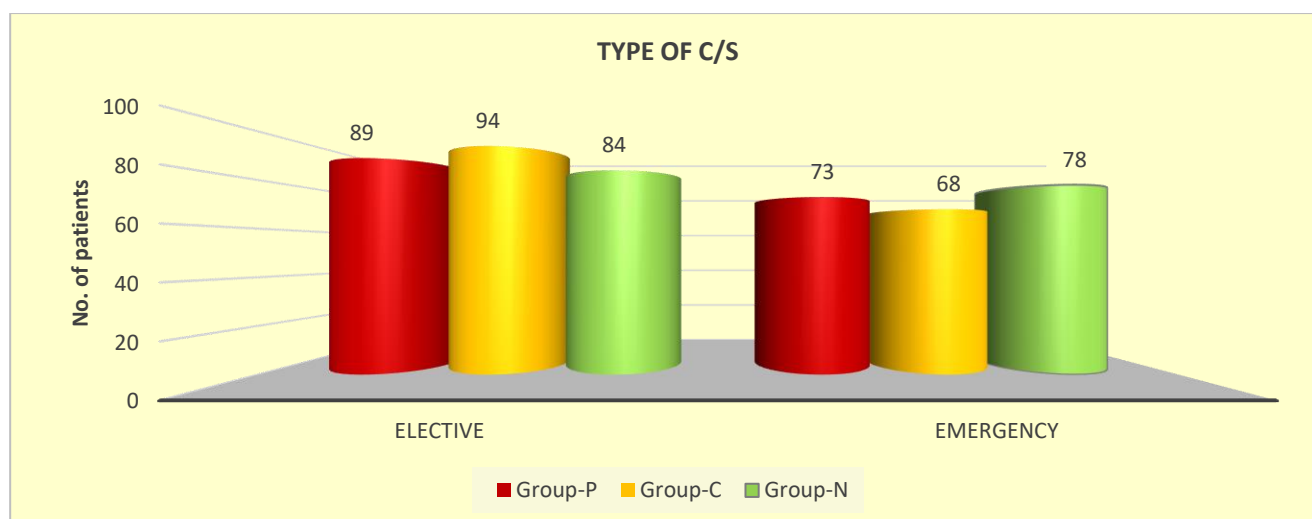


Figure 4: Types of CS among study participants.

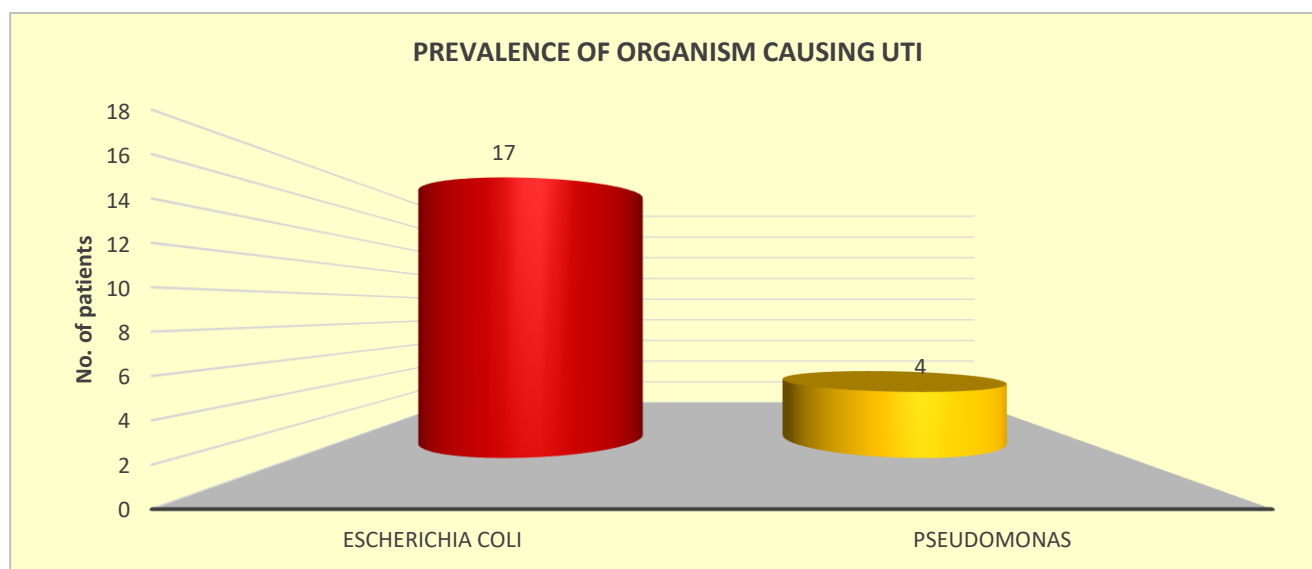


Figure 5: Prevalence of organisms causing urinary tract infection among study participants.

DISCUSSION

The mean maternal age across the three groups-Group-P (Povidone-Iodine), Group-C (Chlorhexidine), and Group-N (No Preparation)-ranged between 28-29 years, with no significant difference ($p=0.289$), indicating demographic comparability. Similar results were observed by Ahmed et al (28.8 ± 9.1 vs. 29.2 ± 7.9 years, $p=0.7$) and Felder et al (29.6 ± 6.12 vs. 30.8 ± 6.08 years, $p=0.765$).^{10,11} Gestational age showed a significant difference ($p=0.004$), with Group-C (39.12 ± 1.35 weeks) having the highest mean value, likely due to a higher rate of elective caesareans, unlike Ahmed et al and Felder et al who reported no significant variation.^{10,11} The mean duration of labour was longer in Group-N (6.58 ± 2.58 hours) than in Group-P (6.15 ± 2.42 hours) and Group-C (5.87 ± 2.14 hours), though not statistically significant ($p=0.078$). Prolonged labour without antiseptic preparation may increase infection risk, as also noted by Ugadu et al.¹² Mean cervical dilation

before caesarean was slightly higher in Group-N (6.03 ± 1.96 cm) compared to Group-P (5.64 ± 1.88 cm) and Group-C (5.37 ± 1.62 cm), but the difference was not significant ($p=0.478$), confirming comparable cervical status among groups. The clinical importance of antiseptic vaginal preparation is supported by Caissutti et al who reported up to 77% reduction in endometritis among labouring women and those with PROM.¹³ Likewise, Liu et al and Abrar et al confirmed that vaginal antiseptic preparation significantly reduced postoperative infections, particularly in emergency caesarean deliveries and labouring patients.^{14,15} The mean rupture interval before caesarean was shortest in Group-C (Chlorhexidine) at 3.93 ± 1.58 hours, followed by Group-P (Povidone-Iodine) at 4.23 ± 1.76 hours, and longest in Group-N (No preparation) at 4.56 ± 1.87 hours, showing a significant difference ($F=3.424$, $p=0.033$). Although categorical analysis (<3, 3-6, >6 hours) was not significant ($p=0.693$), Group-C had fewer cases with prolonged rupture (>6

hours), correlating with the lowest postoperative infection rates. These results align with Liu et al who reported that vaginal antiseptic cleansing with iodine or chlorhexidine reduced endometritis, postoperative fever, and wound infections, particularly in PROM cases.¹⁴ Similarly, Abrar et al found significant reductions in febrile morbidity and postoperative infections ($p<0.001$) with vaginal preparation in women with PROM.¹⁵ Together, these findings highlight the protective role of timely vaginal antiseptic cleansing in minimizing infection risk after membrane rupture. The distribution of elective and emergency caesarean sections was similar across groups ($p=0.536$), though infections were lower in elective cases. Liu et al and Biggar et al reported that antiseptic vaginal cleansing provides the greatest benefit in emergency caesareans, significantly reducing endometritis and postoperative fever. In our study, Group-N (no preparation) showed higher infection rates: fever (12.9% vs. 5.56% in Group-P and 3.70% in Group-C), endocervical colonization (10.49% vs. 5.56% and 4.32%), UTIs (6.17% vs. 2.47% and 4.32%), and endometritis (1.23%, only in Group-N).^{14,16} Similar benefits with chlorhexidine were observed by Marzouk et al and Ahmed et al while Roeckner et al confirmed the efficacy of povidone-iodine in lowering endometritis, wound infections, and fever. Kaur et al and Salvi et al also noted reduced febrile morbidity with povidone-iodine.^{10,17,19} Culligan et al demonstrated superior bacterial clearance with chlorhexidine, and Felder et al reported fewer postoperative infections with chlorhexidine.^{11,20,21} Overall, our findings and existing literature confirm that vaginal antiseptic preparation-particularly with chlorhexidine-significantly reduces postoperative infections, especially in high-risk or emergency caesarean deliveries. Surgical site infections (SSIs) were highest in Group-N (no preparation), with wound discharge in 6.79%, foul-smelling discharge in 8.64%, and erythema/oedema in 5.56%, compared to lower rates in Group-P (4.94%) and Group-C (4.32%), demonstrating the protective effect of vaginal antiseptic preparation. Lakhi et al and Felder et al similarly reported reduced SSIs and postoperative fever with chlorhexidine use.^{11,22} Biswas et al found that povidone-iodine significantly reduced endometritis (2.61% vs. 9.12%, $p=0.001$) and fever (4.89% vs. 12.05%, $p=0.001$), while Salvi et al also reported lower rates of fever, wound infection, and endometritis with antiseptic cleansing.^{20,23} Overall, our findings and prior evidence confirm that vaginal antiseptic preparation-particularly with chlorhexidine or povidone-iodine-significantly lowers SSIs, endometritis, and postoperative fever after caesarean section. The mean postoperative hospital stay was shortest in Group-C (chlorhexidine) at 4.77 ± 0.92 days, compared to Group-P (5.86 ± 1.23) and Group-N (6.54 ± 1.47), with a highly significant difference ($p=0.0001$). Most Group-C patients (63.6%) were discharged within 5 days, indicating faster recovery with chlorhexidine. Ugadu et al and Abro et al similarly reported shorter hospital stays and fewer complications after vaginal cleansing.^{12,24} Liu et al in a meta-analysis of 23 RCTs (over 10,000 women), confirmed that antiseptic

preparation reduced postoperative fever (7.1% vs. 11.4%) and wound infection (4.1% vs. 5.4%), leading to shorter hospital stays.¹⁴ These findings emphasize the clinical and economic benefits of vaginal antiseptic preparation, particularly with chlorhexidine, in promoting faster recovery after caesarean delivery. *E. coli* (80.95%) was the predominant pathogen in postoperative UTIs, followed by *Pseudomonas* species (19.05%). This aligns with global trends where *E. coli* is the leading uropathogen in post-caesarean and catheterized patients. The higher UTI rate in Group-N likely reflects the absence of vaginal preparation. Kaur et al and Culligan et al also found that antiseptic vaginal cleansing before caesarean delivery reduces colonization by pathogens like *E. coli*, lowering postoperative UTI risk.^{19,21} Although cetrimide was not studied here, Salvi et al and Biswas et al reported that it reduces postoperative fever and endometritis.^{20,23} While less potent than povidone-iodine or chlorhexidine, cetrimide may serve as an alternative for patients allergic to iodine- or guanidine-based antiseptics. Further trials are warranted to confirm its efficacy and safety. No adverse effects such as dermatitis, mucosal irritation, or systemic reactions were observed in Group-C or Group-P, confirming their safety. Liu et al and Roeckner et al similarly reported no rise in adverse events with vaginal antiseptic use.^{14,18} Lakhi et al noted minor logistical issues but significant infection reduction.²² Given their safety, affordability, and ease of use, routine vaginal antiseptic preparation-especially with chlorhexidine-should be adopted. Chlorhexidine reduces hospital stay and wound complications, while povidone-iodine more effectively lowers fever, UTI, and endometritis. Further large-scale trials are recommended.

CONCLUSION

The study demonstrated that preoperative vaginal antiseptic cleansing with chlorhexidine or povidone-iodine effectively reduces postoperative infectious morbidity and shortens hospital stay in women undergoing CS. Both antiseptics were safe, affordable, and easy to apply, showing clear benefits over no preparation, which was associated with higher infection rates and longer recovery. Chlorhexidine provided slightly superior results in reducing hospital stay, while povidone-iodine was effective in minimizing fever and urinary infections. The benefits were more evident in high-risk cases such as prolonged labor, premature rupture of membranes, and multiparity, supporting the inclusion of vaginal antiseptic preparation as a routine preoperative practice to improve maternal outcomes and decrease healthcare burden. Nevertheless, this single-center study did not stratify outcomes for specific high-risk groups such as patients with premature rupture of membranes or emergency caesarean sections, which may limit the depth and generalizability of its findings. Future multicenter studies with larger and more diverse populations are recommended to validate these results and explore the effectiveness of vaginal antiseptic preparation across different risk categories.

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