



A RANDOMIZED CONTROLLED TRIAL COMPARING CHLORHEXIDINE-ALCOHOL WITH POVIDONE-IODINE AS SKIN ANTISEPTIC AGENT AT CAESAREAN DELIVERY

Dr Sumana Nandi

Contractual Senior Resident, Department of Obstetrics & Gynaecology, Onda Super Speciality Hospital, Bankura, West Bengal

Dr Ashish Seal*

Associate Professor, Department of Obstetrics & Gynaecology, Ramakrishna Mission Seva Pratishthan, Vivekananda Institute of Medical Sciences, Kolkata, West Bengal*Corresponding Author

Dr Sukanta Misra

Professor & Head of the Department, Department of Obstetrics & Gynaecology, Ramakrishna Mission Seva Pratishthan, Vivekananda Institute of Medical Sciences, Kolkata, West Bengal

ABSTRACT **Background:** Post-operative abdominal wound infection represents a substantial burden of disease both for the patients and the health-care services in terms of the morbidity and economic costs. Although surgical wound infections cannot be completely eliminated, a reduction in infection rate to a minimal, may have significant benefits. **Aim and Objectives:** To study the effectiveness of chlorhexidine-alcohol vs povidone-iodine as pre-operative skin preparation in prevention of SSI. **Materials and Methods:** Study Design: Randomized control trial. Place of Study: Operation theatre of Ramakrishna Mission Seva Pratishthan Hospital. Period of Study: May 2018-April 2019. Study Population: Pregnant population undergoing cesarean section. Sample Size: 1000 pregnant women, 500 in each group. Methodology: Pre-operative skin preparation with chlorhexidine-alcohol and povidone-iodine was done. The suture-line was evaluated at Day3 and Day30 and diagnosis of any infection and management were done. **Results:** 31(3.1%) patients had SSI at Day3 out of which 8(1.6% of total) were from C-arm group and 23(4.6% of total) were from P-arm group (statistically significant). 4(0.4% of total) had Deep-incisional(DI) infection and 27(2.7% of total) had superficial-incisional(SI) infection. 4(0.4%) patients had SSI at Day30 out of which 1(0.2% of total) were from C-arm group and 3(0.6%) were from P-arm group (not significant). 1(0.1% of total) had Deep-incisional(DI) infection and 3(0.3% of total) had superficial-incisional(SI) infection. **Conclusion:** Preoperative cleansing of the patient's skin with chlorhexidine-alcohol is superior to cleansing with povidone-iodine for preventing and minimizing surgical-site infection after cesarean delivery.

KEYWORDS : Surgical Site Infection(SSI), Caesarean delivery.

INTRODUCTION

Health care-associated infections(HAIs) are acquired by the patients while receiving care. These are the most frequent adverse events affecting patients' safety worldwide. The endemic burden of HAIs is significantly higher in low-and middle-income countries than in high-income nations. The common HAIs include urine, chest, blood and wound infections¹.

Surgical Site Infection is the infection at the site of surgery that occurs within 30 days of surgery if there is no implant (hardware, artificial graft, mesh etc) or occurs within 1 year of the surgery with an implant in place². The CDC definition describes three levels of SSI – Superficial Incisional, Deep Incisional and Organ or Space Infection³. Cesarean section is the commonest abdominal surgery performed by Obstetricians. With the increase in the number of C-sections being performed, the incidence of SSI has increased and in most instances are avoidable⁴. SSI complicates a significant number of patients who undergo C-sections.

SSI after C-section increases the post-operative maternal morbidity and extra economic burden to the patient and to the health care system⁵. Therefore, prevention of SSI is extremely important for both the patient and the doctors.

The risk factors for SSI include maternal factors-tobacco use, limited prenatal care, obesity, previous CD, intrapartum and operative factors-chorioamnionitis, PROM, prolonged rupture of membranes, prolonged labor, large incision length, subcutaneous tissue thickness >3cm, emergency delivery, excessive blood loss⁶. Many perioperative measures for decreasing SSI have been reported, including enhanced nutritional support, surgical technique, hair removal methods, wound dressing, perioperative use of the antibiotic and use of antiseptic skin-preparatory agent⁷.

In the present study, we address the use of two different antiseptic skin-preparations for pre-operative skin care-2% chlorhexidine-alcohol and 10% povidone-iodine. Both preparations have broad-spectrum antibacterial effectiveness. However, Povidone-iodine's activity is decreased in the presence of organic materials including blood or pus⁸. While, Chlorhexidine-alcohol has high antibacterial activity against some pathogens, such as methicillin-resistant Staphylococcus

aureus(MRSA) and vancomycin-resistant enterococci(VRE); nevertheless it is more expensive than povidone-iodine and has been linked to allergic reactions⁹.

AIM & OBJECTIVES

General: To find out:

- 1) the incidence of SSI after use of chlorhexidine-alcohol as a skin-preparatory-agent at caesarean-delivery.
- 2) the incidence of SSI after use of povidone-iodine as a skin-preparatory-agent at caesarean-delivery.

Specific: To assess the comparative-efficacy of chlorhexidine-alcohol surgical-scrub versus povidone-iodine surgical-scrub as an antiseptic skin agent at caesarean-delivery to prevent SSI.

MATERIALS & METHODS

Study Design: Randomized control trial

Place of Study: Operation theatre of Ramakrishna Mission Seva Pratishthan Hospital.

Period of Study: May 2018-April 2019(One Year).

Study Population: Pregnant population undergoing caesarean-section

Sample Size: 1000 pregnant women.

Inclusion Criteria:

- 1) More than 18 years of age
- 2) Having CS in a pregnant of >36 weeks
- 3) Could provide informed consent

Exclusion Criteria:

- 1) Pre-existing skin diseases at the site of infection
- 2) Sensitivities to chlorhexidine and povidone-iodine
- 3) Clinical chorioamnionitis
- 4) PROM
- 5) Morbidly Obese (BMI >40 kg/m²)
- 6) Prolonged labor >24hours
- 7) Uncontrolled Diabetes or GDM
- 8) Hypertension in pregnancy

- 9) Chronic respiratory disorders
- 10) Smokers
- 11) Massive PPH
- 12) Anemia

Statistical analysis: was performed with help of Epi Info (TM) 7.2.2.2 EPI INFO is a trademark of the Centers for Disease Control and Prevention(CDC). P-value <0.05 was taken to be statistically significant.

Methodology: The pregnant women admitted in the ante-natal and labor ward requiring elective/emergency cesarean section were recruited based on the inclusion and exclusion criteria. A written informed consent was obtained from each subject. The study-participants were randomized into two groups based on the computer generated random-numbers(b/w 0003-1002).

Group C-arm = received 2% chlorhexidine-alcohol as skin-preparatory-agent before c-section.

Group P-arm = received 10% povidone-iodine as skin-preparatory-agent before c-section.

Hair removal was done by clipping in all patients under strict aseptic conditions on the same day of c-section. Single dose of 1.5gm ceftriaxone+sulbactam combination was given to each participant by intra-venous route at-least 1 hour before the skin incision.

Pre-operative skin preparation of respective groups done. A contact time of 3 minutes was maintained for skin preparation with chlorhexidine-alcohol and 2 minutes contact time was maintained for povidone-iodine group. Draping was done, then standard LUCS performed.

After delivery of the baby, placenta was allowed for spontaneous delivery with gentle cord traction. Both intra-abdominal and extra-abdominal repair of uterine-incision were done and uterine incision closed by double-layer technique. Closure of the peritoneum was dependent on the choice of the conducting surgeon. Subcutaneous tissue closure was done only if subcutaneous thickness >2cm. Skin suturing was done in form of vertical mattress suture with no 2-0 ethilon. Suture-line was covered with Leukoband (Elastic Adhesive Bandage) maintaining aseptis.

In the post-natal ward, suture-line evaluation was done on Day3 after removal of the dressing using an aseptic non-touch technique according to NICE guidelines¹⁰. Diagnosis of any infection and its management were done according to WHAIP (Welsh Healthcare Associated Infection Programme) Diagnostic tool¹¹. Suture-line was surveyed carefully to search for any evidence of discharge from the scar-line, pain/tenderness, localized swelling, redness, wound-gapping and was classified into superficial-incisional, deep- incisional or organ/space infection. Management of surgical site infection was done according to WHAIP guidelines.

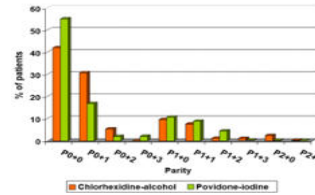
Follow-up: All pregnant women were asked to visit gynae OPD at day30 or earlier if necessary for routine checkup and re-evaluation of the LSCS wound. 49 patients didn't come for follow-up, among them 23 belong to the chlorhexidine- group and 26 belong to the povidone-iodine group.

RESULTS & ANALYSIS

50%(n=500) patients were treated with Chlorhexidine-alcohol(C-arm Group) and rest 50%(n=500) patients were treated with Povidone-iodine(P-arm Group).

The Mean Age(mean±s.d)(in years) of C-arm group was 27.81±4.64 and P-arm group was 27.55±4.34. There was no significant association between age group and the patients of the two groups (p=0.31, Chi-square {χ²} test). Thus, the patients of the two groups were matched for their ages.

The Mean BMI(mean±s.d)(in kg/m²) of C-arm group was 25.73±2.71 and P-arm group was 25.54±2.92. There was no significant association between BMI and the patients of the two groups (p=0.55, Chi-square test). Thus, the patients of the two groups were matched for their BMI.



Chi-square test showed that there was no significant association between parity and the patients of the two groups(p=0.33).

The Mean Gravida(mean±s.d) of the patients of C-arm group was 1.79±0.82 and P-arm group was 1.69±0.92. There was no significant association between gravida and the patients of the two groups(p=0.64, Chi-square test). Thus, the patients of the two groups were matched for their number of gravidae.

The Mean Period of Gestation(mean±s.d)(in weeks) of C-arm group was 38.75±1.11 and P-arm group was 39.20±0.92. There was no significant association between period of gestation and the patients of the two groups(p=0.22, Chi-square test). Thus, the patients of the two groups were matched for their period of gestation.

The Mean Duration of Labor(mean±s.d)(in hours) of C-arm group was 6.44±1.80 and P-arm group was 6.16±1.66. There was no significant association between duration of labor and the patients of the two groups(p=0.41, Chi-square test). Thus, the patients of the two groups were comparable for their duration of labor. 516 patients had undergone Elective CS out of which 267(51.7%) belonged to C-arm group and 249(48.3%) belonged to P-arm group. 484 patients had Emergency CS out of which 233(48.1%) belonged to C-arm group and 251(51.9%) belonged to P-arm group. There was no significant association between mode of delivery and the patients of the two groups(p=0.25, Chi-square test). Thus, the patients of the two groups were matched for their mode of delivery.

The Mean Duration of LSCS(mean±s.d)(in minutes) of C-arm group was 35.28±5.24 and P-arm group was 36.00±4.82. There was no significant association between duration of LSCS and the patients of the two groups(p=0.31, Chi-square test). Thus, the patients of the two groups were matched for their duration of LSCS.

The Mean Number of P/V(mean±s.d) of C-arm group was 3.40±1.06 and P-arm group was 3.45±0.85. There was no significant association between number of P/V and the patients of the two groups(p=0.71, Chi-square test). Thus, the patients of the two groups were comparable for their number of P/V.

31(3.1%) patients had SSI at Day3 out of which 8(1.6% of total) were from C-arm group and 23(4.6% of total) were from P-arm group. There was significant association between SSI at Day3 of the patients of the two groups(p=0.0062, Chi-square test).

Out of 31 patients with SSI at Day3, 4(0.4% of total) had Deep-incisional(DI) infection and 27(2.7% of total) had superficial-incisional(SI) infection. Out of the DI patients, 1 belonged to C-arm group and 3 belonged to P-arm group. Out of the SI patients, 7 belonged to C-arm group and 20 belonged to P-arm group. Both proportion of both DI and SI were significantly higher among the patients treated with Povidone-iodine as compared to the patients treated with Chlorhexidine-alcohol(Z=7.07;p<0.001).

4(0.4%) patients had SSI at Day30 out of which 1(0.2% of total) were from C-arm group and 3(0.6%) were from P-arm group. There was no significant association between SSI at Day30 and the patients of the two groups(p=0.31, Chi-square test). The risk of SSI at Day30 was 3.03 times more among the patients treated with Povidone-iodine as compared to the patients treated with Chlorhexidine-alcohol but the risk was not significant.

Out of 4 patients with SSI at Day30, 1(0.1% of total) had Deep-incisional(DI) infection and 3(0.3% of total) had superficial-incisional(SI) infection. The DI patient belonged to P-arm group. Out of the SI patients, 1 belonged to C-arm group and 2 belonged to P-arm group. There was no significant association between type of SSI at Day30 and the patients of the two groups(p=0.51, Chi-square test). Thus, types of SSI at Day30 were more or less equally distributed among the patients of the two groups. However, proportion of both DI

Fig 1: Distribution of parity and the patients of two groups.

(0.2%) and SI (0.4%) were higher in Povidone-iodine group but it was not significant ($Z=0.44$; $p=36$).

DISCUSSION

In our study, the patients of the Chlorhexidine-alcohol group and Povidone-iodine group, were matched for their ages. T-test showed that there was no significant difference in mean age of the two groups ($t_{998}=1.73$; $p=0.21$). Devjani et al¹¹ found increased age as a risk-factor significantly associated with SSI.

In our study, the patients of the two groups were matched for their BMI. T-test showed that there was no significant difference in mean BMI of the patients of the two groups ($t^{998}=1.34$; $p=0.38$). In Vegel et al¹² study, SSIs were significantly more prevalent in the population with obesity and the rate of SSI increased incrementally with each increase in BMI, where the highest rates were observed in patients with morbid obesity ($BMI \geq 40.0 \text{ kg/m}^2$). In our study, patients with morbid obesity were excluded.

Our study showed that nulliparous women were more prone to SSI after C-section, similar to Kurz et al¹³ study.

Amenu et al¹⁴ studies have shown that cases of prolonged/obstructed labor associated with higher incidence of SSI. In our study, the patients of the two groups were comparable for their duration of labor.

In chlorhexidine-alcohol group the range of duration of LSCS was 26-51 minutes and the mean duration of LSCS was 35.28 ± 5.24 minutes. In the povidone-iodine group the range of duration of LSCS was 27-51 minutes and the mean value was 36.00 ± 4.82 minutes. Shapiro et al¹⁵ reported that with each hour of surgery the infection rate doubles.

In our study, the range of the number of P/V examination during the labor period was 1-5 both in chlorhexidine-alcohol group and the povidone-iodine group. In the chlorhexidine-alcohol group the mean was 3.40 ± 1.06 and in the povidone-iodine group mean was 3.45 ± 0.85 . In Filbert et al¹⁶ study, multiple per-vaginal examinations were found to be more predisposed to surgical site infections.

In Darouchie et al¹⁷, both studies showed that the overall rate of SSI after cesarean section was significantly lower in chlorhexidine-alcohol group than in the povidone-iodine group. This was similar to our study where the proportion and overall rate of SSI at day3 was lower in chlorhexidine-alcohol group than povidone-iodine group which was statistically significant. The risk of SSI at Day3 among the patients treated with Povidone-iodine was 2.96 times more than that of the patients treated with Chlorhexidine-alcohol.

In our study, Proportion of both SI and DI at Day3 were significantly higher among the patients treated with Povidone-iodine as compared to the patients treated with chlorhexidine-alcohol ($Z=7.07$; $p<0.001$). This was similar to Springel EH et al¹⁸ study.

In our study, Proportion of SSI at Day30 was higher among the patients treated with povidone-iodine as compared to the patients treated with chlorhexidine-alcohol, but not significant statistically. The risk of SSI at Day30 was 3.30 times more among the patients treated with povidone-iodine as compared to the patients with chlorhexidine-alcohol but not significant. Kesani VP et al¹⁹ study also showed lower incidence of SSI in chlorhexidine-alcohol group at Day30 follow-up than the povidone-iodine group.

The proportion of both SI and DI at Day30 were higher in povidone-iodine group but it was not statistically significant, similar to Kesani VP et al¹⁹ study.

CONCLUSION

Preoperative cleansing of the patient's skin with chlorhexidine-alcohol is superior to cleansing with povidone-iodine for preventing and minimizing surgical-site infection after cesarean delivery. A multi-centric randomized trial with a large heterogenous population would help to clinch the conclusion in a more confirmatory way.

REFERENCES:

- [1] Haque M, Sartelli M, McKimm J, Abu Bakar M. Health care-associated infections - an overview. *Infect Drug Resist.* 2018 Nov 15;11:2321-2333.
- [2] Horan TC, Gaynes RP, Martone WJ, Jarvis WR, Emori TG. CDC definitions of nosocomial surgical site infections, 1992: a modification of CDC definitions of surgical wound infections. *Infect Control Hosp Epidemiol.* 1992 Oct;13(10):606-8.
- [3] Onyekwelu I, Yakkanti R, Protzer L, Pinkston CM, Tucker C, Seligson D. Surgical

- Wound Classification and Surgical Site Infections in the Orthopaedic Patient. *J Am Acad Orthop Surg Glob Res Rev.* 2017 Jun 13;1(3):e022.
- [4] Gur R, Duggal SD, Rongpharpi SR, Srivastava R, Kumar A, Gupta V et al. Post caesarean surgical site infections. *Archives of Clinical Microbiology.* 2015 Jan 1;6(1).
- [5] Al Jama FE. Risk factors for wound infection after lower segment cesarean section. *Qatar Med J.* 2013 Nov 1;2012(2):26-31.
- [6] Kawakita T, Landy HJ. Surgical site infections after cesarean delivery: epidemiology, prevention and treatment. *Matern Health Neonatol Perinatol.* 2017 Jul 5;3:12.
- [7] Hranjec T, Swenson BR, Sawyer RG. Surgical site infection prevention: how we do it. *Surg Infect (Larchmt).* 2010 Jun;11(3):289-94.
- [8] Zamora JL, Price MF, Chuang P, Gentry LO. Inhibition of povidone-iodine's bactericidal activity by common organic substances: an experimental study. *Surgery.* 1985 Jul;98(1):25-9.
- [9] Lee I, Agarwal RK, Lee BY, Fishman NO, Umscheid CA. Systematic review and cost analysis comparing use of chlorhexidine with use of iodine for preoperative skin antiseptics to prevent surgical site infection. *Infect Control Hosp Epidemiol.* 2010 Dec;31(12):1219-29.
- [10] Surgical site infections: prevention and treatment. London: National Institute for Health and Care Excellence (NICE); 2020 Aug 19. (NICE Guideline, No. 125.) Available from: <https://www.ncbi.nlm.nih.gov/books/NBK542473/>
- [11] De D, Saxena S, Mehta G, Yadav R, Dutta R. Risk Factor Analysis and Microbial Etiology of Surgical Site Infections following Lower Segment Caesarean Section. *International Journal of Antibiotics, vol. 2013, Article ID 283025, 6 pages, 2013.* <https://doi.org/10.1155/2013/283025>
- [12] Vegel AJ, Benden DM, Borgert AJ, Kallies KJ, Kothari SN. Impact of Obesity on Cesarean Delivery Outcomes. *WMJ.* 2017 Nov;116(4):206-209.
- [13] Kurz A, Sessler DI, Lenhardt R. Perioperative normothermia to reduce the incidence of surgical-wound infection and shorten hospitalization. Study of Wound Infection and Temperature Group. *N Engl J Med.* 1996 May 9;334(19):1209-15.
- [14] Amenu D, Belachew T, Araya F. Surgical site infection rate and risk factors among obstetric cases of jimma university specialized hospital, southwest ethiopia. *Ethiop J Health Sci.* 2011 Jul;21(2):91-100.
- [15] Shapiro M, Muñoz A, Tager IB, Schoenbaum SC, Polk BF. Risk factors for infection at the operative site after abdominal or vaginal hysterectomy. *N Engl J Med.* 1982 Dec 30;307(27):1661-6.
- [16] Mpororo FJ, Mshana SE, Mirambo MM, Kidenya BR, Gumodoka B, Imirizioluoglu C. Incidence and predictors of surgical site infections following caesarean sections at Bugando Medical Centre, Mwanza, Tanzania. *Antimicrob Resist Infect Control.* 2014 Aug 11;3:25.
- [17] Darouchie RO, Wall MJ Jr, Itani KM, Otterson MF, Webb AL, Carrick MM, Miller HJ, Awad SS, Crosby CT, Mosier MC, Alsharif A, Berger DH. Chlorhexidine-Alcohol versus Povidone-Iodine for Surgical-Site Antisepsis. *N Engl J Med.* 2010 Jan 7;362(1):18-26.
- [18] Springel EH, Wang XY, Sarfoh VM, Stetzer BP, Weight SA, Mercer BM. A randomized open-label controlled trial of chlorhexidine-alcohol vs povidone-iodine for cesarean antisepsis: the CAPICA trial. *Am J Obstet Gynecol.* 2017 Oct;217(4):463.e1-463.e8.
- [19] Kesani VP, Talasila S, Sheela SR. Chlorhexidine-alcohol versus Povidone-Iodine-alcohol for surgical site antisepsis in caesarean section. *Int J Reprod Contracept Obstet Gynecol.* 2019 Apr;8(4):1359-62.