

Povidone Iodine: The Reliable Antimicrobial in Orthopedic Surgeries

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Abstract

Background: This study was conducted to know the effectiveness of surgical site skin preparation using povidone-iodine (PVP-I) scrub and solution on orthopedic patients and their post-operative rate of surgical site infection.

Materials and Methods: This observational study was conducted in the Department of Orthopaedics, L.N. Medical College and Research Centre and J.K. Hospital, Bhopal, M.P. India over a period of 6 months from July 2019 to December 2019 to know the effectiveness of surgical site skin preparation using PVP-I scrub and solution on orthopedic patients.

Results: In the present study, out of 50 subjects, 40 (80%) were operated for closed fractures of various sites, in 3 (6%) patients, knee replacement was done, in 3 (6%) patients, hip replacement was done, while 4 (8%) patients were operated for spinal surgery. Hospital stay for 27 (54%) subjects was 1–2 days, hospital stay for 11 (22%) subjects was 4–5 days, while hospital stay for 12 (24%) subjects was 10 days. Drainage was kept in 10 (22%) subjects while there was no need of drainage in 39 (78%) subjects. Out of 40 subjects operated for closed fractures of various sites, only 1 had infection, out of 3 of knee replacement, three subjects of hip replacement and 4 subjects of spinal surgery, not a single subject had infection. Thus, the infection rate was 2% i.e. very low.

Conclusion: PVP-Iodine is the reliable antimicrobial agent for the Prevention of surgical site skin infection.

Key words: Povidone iodine solution, Povidone iodine-1, Surgical scrub, Surgical site infection

INTRODUCTION

Although infrequent but surgical site infection (SSI) is a serious complication of surgery. Frequently, postoperative infection requires repeat surgery. Furthermore, it may lead to prolonged hospitalization and may compromise ultimate surgical outcomes.^[1]

Preventive measures are taken in preoperative, intraoperative and postoperative periods. Preoperative preventive measures include the use of perioperative antibiotics, proper nutrition to the patient, and monitoring blood glucose in diabetics. Intraoperative measures include proper skin preparation before surgery, shorter surgical

time, frequent changing of gloves, cement impregnated with antibiotic, and antiseptic irrigation before closure. Postoperative preventive measures include continuing antibiotics for 24 h after surgery and reducing allogeneic blood transfusions.^[2]

The causes of SSI are multifactorial, and they comprise patient and procedure-specific risks. According to Schuster *et al.*, age >60 years, diabetes, malnutrition, obesity, American Society of Anesthesiologists score ≥ 3 , higher glucose level, transfusions, posterior approach, and duration of surgery are the risk factors in spine surgery in the preoperative and intraoperative period.^[3]

Commonly used antiseptic solutions include chlorhexidine digluconate, hydrogen peroxide, sodium hypochlorite, and povidone-iodine (PVP-I).^[4]

The ideal antiseptic solution has minimal cytotoxicity at its minimal bactericidal concentration (MBC). MBC is defined as the concentration required to diminish the bacterial load by 99.9%. PVP-I permits cell viability at its MBC.^[4]

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Lugol's solution was developed in 1829. It was the mixture of elemental iodine and potassium in water. Davaine in 1882 first studied the antimicrobial action of iodine.^[5]

Lugol's iodine was used in 1819 to prevent surgical infection from the skin site.^[6] WHO evidence-based guidelines for SSI prevention recommends, irrigation of incisional wounds of clean or clean-contaminated wounds using an aqueous PVP-I solution before closure.^[7]

The skin prep is begun at the planned incision site and carried to the periphery. It should be done using widening circular motion. When the periphery of the skin prep is reached, the sponge should be discarded. It should not be brought back over the clean area. The prepping always progresses from the clean to the dirty area. The paint solution should be applied with prep stick sponges, using the no-touch technique. CHG, alcohol, and alcohol-based agents should not be used on mucous membranes. Gentle pressure should be used while applying the prep agents on patients with friable skin.^[8]

PVP-I markedly reduces the SSI intra-operatively and postoperatively by its anti-microbial activity, by increasing epithelization of chronic wound and nontoxic effect on fibroblastic activity.^[9]

Commonly used aqueous-based iodophors PVP-I, require two-step application. First as a scrub and then as a solution. Alcohol-based solution containing iodophors or chlorhexidine gluconate have sustained and durable anti-microbial activity and one-step application. However, they have limited use in comparison with PVP-I.^[10]

PVP-I (Betadine) is an antiseptic solution consisting of polyvinylpyrrolidone with water, iodide, and 1% available iodine. It has bactericidal activity against a large number of pathogens.^[11]

Aims and Objectives

To know the prevalence of surgical site skin infection using PVP-I scrub and solution on orthopedic patients.

MATERIAL AND METHODS

This observational study was conducted in the Department of Orthopaedics, L.N. Medical College and Research Centre and J.K. Hospital, Bhopal, M.P. India over a period of 6 months from July 2019 to December 2019. A convenient sample of 50 operated patients seeking treatment and care at tertiary care hospital and who consented to participate in the study and for observation till the follow-up period of 6 months were selected. Preoperative, intraoperative and postoperative assessments were done and SSIs were

recorded in a pre-designed proforma along with baseline demographics of the patients.

Inclusion Criteria

1. Clean patients such as closed fracture of various sites
2. Knee replacement
3. Hip replacement
4. Severe osteoarthritis knee
5. Avascular necrosis hip
6. Prolapse intervertebral disc.

Exclusion Criteria

1. Compound fracture
2. Infected nonunion
3. Infected implant removal.

Composition of PVP-I

PVP-I IP 10%.

Composition of Surgical Scrub

PVP-I IP 7.5%.

All 50 patients were advised to clean the affected limb before surgery. The two step skin preparation was used. The area to be operated was shaved and then 7.5% 5–10 ml PVP-I surgical scrub was applied on the skin. The scrub was washed with normal saline. The area was then painted with 10% PVP-I solution over the site to be operated on and over the whole limb. The paint was kept for at least 10 min or till it get dried before incision.

All operated patients were given intravenous antibiotics for at least 3 days. Dressing was done on 2nd and 5th post-operative day using 10% PVP-I solution. Patients were called for regular follow-up depending on the condition of wound, area operated and type of implant used. Data were entered in Microsoft excel sheet and analyzed using descriptive statistics such as frequency, percentages, and confidence interval.

RESULTS

In the present study, out of 50 subjects, 10 (20%) subjects were in 21–30 years age group, 7 (14%) subjects were in 31–40 years age group, 10 (20%) subjects were in 41–50 years age group, 8 (16%) subjects were in 51–60 years age group, while maximum subjects, i.e. 15 (30%) subjects were in >60 years age group [Table 1].

In the present study, 20 (40%) subjects were male, whereas there were more number, i.e. 30 (60%) of females. Female-to-male ratio was 1.5:1 [Table 2].

In the present study, out of 50 subjects, 40 (80%) were operated for closed fractures of various sites, in 3 (6%)

subjects, knee replacement was done, in 3 (6%) subjects, hip replacement was done, while 4 (8%) subjects were operated for spinal surgery. Thus, majority of subjects were operated for fracture [Table 3].

In the present study, out of 50 subjects, hospital stay for majority, i.e. 27 (54%) (39.3–68.2%, 95%CI) subjects was 1–2 days, hospital stay for 11 (22%) (39.3–68.2%, 95%CI) subjects was 4–5 days, while hospital stay for 12 (24%) (13.1–38.2%, 95%CI) subjects was 10 days [Table 4].

Hospital Stay is One of the Important Indicator of Successful Outcome of Surgery

In the present study, out of 50 subjects, drainage was kept in 11 (22%) (11.5–36.0%, 95%CI) subjects while there was no need of drainage in 39 (78%) (64.0–88.5%, 95%CI) subjects [Table 5].

In the present study, out of 40 subjects operated for closed fractures of various sites, only 1 (2.5%) (0.0–13.2%, 95%CI) had infection, out of 3 of knee replacement, three subjects of hip replacement, and four subjects of spinal surgery, not a single subject had infection. Thus, the overall prevalence of infection was 2% (0.0–10.6, 95%CI) (very low) [Table 6].

DISCUSSION

In the present study, out of 50 subjects, 10 (20%) subjects were in 21–30 years age group, 7 (14%) subjects were in 31–

40 years age group, 10 (20%) subjects were in 41–50 years age group, 8 (16%) subjects were in 51–60 years age group while maximum subjects i.e. 15 (30%) subjects were in >60 years age group [Table 1].

Okoro et al. found that the age of the patients ranged from 18 to 68 years and there was no significant difference in the mean age of the study groups, $P = 0.16$.^[12]

In the present study, 20 (40%) subjects were male, while there were more number, i.e. 30 (60%) of females. Female-to-male ratio was 1.5:1 [Table 2]. Okoro et al. found that there were 62 males (53.4%) and 54 females (46.6%). Their study shows the sex distribution in the study groups with a male: female ratio of 1.14:1.^[12]

However, in our study male-to-female ratio was 1:1.5. In the present study, out of 50 patients, 40 (80%) were operated for closed fractures of various sites, in 3 (6%) patients, knee replacement was done, in 3 (6%) patients, hip replacement was done while 4 (8%) patients were operated for spinal surgery [Table 3].

Kumar found that out of 142 patients operated, 99 were fracture patients, 15 joint replacement, 11 implant removal, eight soft tissue procedures, four spine surgeries, four anterior cruciate ligament reconstruction, and one patient was having excision biopsy leg tumor.^[13]

In the present study, out of 40 patients operated for closed fractures of various sites, only one had infection,

Table 1: Age distribution of study subjects

Age group	No. of subjects n=50	Percentage
21–30 years	10	20
31–40 years	7	14
41–50 years	10	20
51–60 years	8	16
>60 years	15	30

Table 2: Sex distribution of study subjects

Sex	No. of subjects n=50	Percentage
Males	20	40
Females	30	60

Table 3: Type of surgeries performed on study subjects

Surgeries performed	Number of subjects n=50	Percentage
Surgery for closed fractures	40	80
Knee replacement	3	6
Hip replacement	3	6
Spine surgery	4	8
Total	50	100

Table 4: Hospital stay of study subjects n=50

Hospital stay of study	Number of subjects	Percentage (95%CI)
1–2 days	27	54 (39.3–68.2)
4–5 days	11	22 (39.3–68.2)
10 days	12	24 (13.1–38.2)

Table 5: Drainage kept

Drainage kept	Number of subjects n=50	Percentage (95%CI)
Drainage kept	11	22 (11.5–36.0)
Drainage not kept	39	78 (64.0–88.5)

Table 6: Prevalence of Infection by type of surgeries performed in study subjects

Surgeries performed	Number of subjects n=50	Percentage of infection (95% CI)
Surgery for closed fractures	40	1/40=2.5 (0.0–13.2)
Knee replacement	3	0 (0)
Hip replacement	3	0 (0)
Spine surgery	4	0 (0)
Total	50	1/50=2 (0.0–10.6)

out of three of knee replacement, three patients of hip replacement and four patients of spinal surgery, not a single patient had infection [Table 3]. Similar to our study, Kumar found that out of 99 patients with closed fracture, three patients got infected but all recovered from the infection (infection rate 3.03%). Out of five infected patients, three were male and three were female. (with 3.52% infection rate).^[13]

In present study, out of 50 subjects, hospital stay for majority, i.e. 27 (54%) (39.3–68.2%, 95%CI) subjects was 1–2 days, hospital stay for 11 (22%) (39.3–68.2%, 95%CI) subjects was 4–5 days while hospital stay for 12 (24%) (13.1–38.2%, 95%CI) subjects was 10 days [Table 4].

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Lin and Hsiao found that there were no significant differences in intraoperative blood loss ($P = 0.873$), length of hospital stay ($P = 0.055$), drainage tube insertion rate ($P = 0.228$), artificial bone material use ($P = 0.071$). Operation time was 4.27 h in control cohort versus 4.09 h in PVI cohort, $P = 0.224$.^[14]

In the present study, out of 40 subjects operated for closed fractures of various sites, only one (2.5%) (0.0–13.2%, 95%CI) had infection, out of three of knee replacement, three subjects of hip replacement and three subjects of spinal surgery, not a single subject had infection. Thus, the overall infection rate was 2% (0.0–10.6, 95%CI) (very low) [Table 6].

Similar to our study, Brown *et al.* found that in operations of TJA, the incidence of SSI was 0.15% with the use of PVP-I.^[15]

Similar to our study, Sindelar and Mason conducted an RCT at the University of Maryland Hospital the infection rate was 2.9% in the treatment group.^[16]

Similar to our study, Cheng *et al.* prospectively investigated 414 spinal surgery patients and compared wounds irrigated with PVP-I solution (3.5% concentration) to wounds irrigated with saline solution. They reported 0% infection

rate in the PVP-I group and 3.4% of infection rate in the saline irrigated wounds (0.5% superficial infections and 2.9% deep infections).^[17]

CONCLUSION

PVP-I is a reliable antimicrobial agent for surgical site skin preparation. It prevents SSIs.

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