International Journal of Research in Orthopaedics
Kumar N. Int J Res Orthop. 2019 Nov;5(6):1065-1068
http://www.ijoro.org

Original Research Article

DOI: http://dx.doi.org/10.18203/issn.2455-4510.IntJResOrthop20194572

A study showing effectiveness of surgical site skin preparation, with two step use of povidone-iodine and postoperative out come in orthopaedic patients

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Received: 18 September 2019
Revised: 02 October 2019
Accepted: 03 October 2019

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ABSTRACT

Background: The most common cause or source of infection in operating room is bacteria coming from inadequate cleaning of skin, surrounding environment, from the staff and from patient itself; especially geriatric with low immunity and diabetic patients. Surgical site skin infection complicates an estimated 5% of all surgeries performed in operation theater. Every measure must be taken to reduce the surgical site infection henceforth reducing the cost of treatment and morbidity of the patient. Povidone-iodine seems to be the best and cheap option.
Methods: One hundred and forty two patients who underwent orthopaedic surgery has been studied for the postoperative outcome following pre-surgical skin preparation with 2 step use of povidone iodine (PVP-I). The area to be operated is scrubbed with PVP-I scrub 7.5% and then painted with 10% PVP-I solution on operative area and wide area above and below. The paint is kept for at least 10 min or till it dry and then washed with normal saline or cleaned with sterile gauze soaked in normal saline. All postoperative patients were given intravenous antibiotics for at least 3 days. Dressing was done with PVP-I as per protocol.
Results: It has been found that out of one hundred and forty two patients studied, only 3.52% developed infection. Out of five infected patients, two were female and three with fracture were male patients.
Conclusions: PVP-I is still one of the best anti-microbial preparation widely used in orthopaedic surgery till date. It has broad spectrum anti-microbial activity and do not have any history of developing any resistance to its content.

Keywords: Povidone-iodine, Surgical site, Scrub, Resistance

INTRODUCTION

The prevention of surgical infection from skin site is most important, as skin being the first barrier to control the infection, needs to have minimal bacterial load before skin incision. To combat this, first iodine preparation used was Lugol's solution that was developed in 1829.[1] It was the mixture of elemental iodine and potassium in water. The antimicrobial action of iodine was first studied by Davaine in 1882.[2] During first world war Alexander Fleming used iodine to reduce the incidence of gas gangrene. In 1950, iodine iodophors were developed to increase the effectiveness and reduce the toxicity of iodine. Modern iodine skin preparations were introduced in 1960s and had become most common iodine preparation in clinical practice. The two preparations were: (a) Povidone iodine (PVP-I) and (b) Cadexomer iodine. The first one is a complex of polyvinylpyrrolidone (known as povidone and PVP) and elemental iodine and the second one is iodine and polysaccharide complex. It is available in different forms; solution, cream, ointment, spray and wound dressing.

Iodine exact mode of action is not fully understood, but it is believed that it rapidly penetrate the cell wall of micro-organisms. This is probably done by blocking hydrogen bonding and altering cell membrane structure.[3]The resistance from iodine is very unlikely because of its multi modal action. It is used for both acute and chronic wound.[4] PVP-I as well as octenidine did not induce catabolic metabolism with an increased loss of proteoglycans. Under the influence of PVP-I, the incorporation rate of 35S-sulfate was increased by 10% and 20%, respectively. This phenomenon of the stimulation of proteoglycan synthesis, has never been reported in the literature for antimicrobials earlier.[5]

Many studies provides overview of surgical skin preparation and rational for the use of 10% povidone-iodine lotion in the area to be operated on, including area above and below the operating site.[6] For bone it is said that once an infection always an infection. For this proverb, PVP-I seems to be appropriate. As PVP-I markedly reduce this complication intra-operatively as well postoperatively by both working as an anti-microbial and as wound healer i.e., by increasing epithelisation of chronic wound and nontoxic effect on fibroblastic activity in humans.[7,8] Reducing bacterial load on the skin at incision site and around decreases chances of surgical site infection.[9] This can be achieved by mechanical procedures i.e., by scrubbing and using detergents to dislodge organic and inorganic substance from the skin and by chemical means by killing micro-organisms.[10]

Many antiseptic agents are available for preparing skin before surgery. Most common are iodophors, chlorhexidine gluconate, and alcohol containing products.

PVP-I is a broad spectrum antiseptic and kills many gram positive bacteria, gram negative bacteria, virus and fungi. The PVP-I kills micro-organism mentioned above by slowly releasing iodine thereby reducing bacterial load on skin and wound even on bacteria with biofilm.[11] A biofilm is a slimy protective mucopolysaccharide glycocalyx cover over bacteria. The iodine is inactivated by the presence of organic material hence should be used on clean skin only, whereever possible.

Commonly used aqueous based iodophors PVP-I, require two step application first as a scrub and then as a paint or solution. Though alcohol based solution containing iodophors or chlorhexidine gluconate have proven sustained and durable anti-microbial activity and one step application but they have limited use as compared to PVP-I.[12] The present study has been conducted to know the effectiveness of surgical site skin preparation using PVP-I scrub and solution on orthopaedic patient and their post-operative outcome.

METHODS

This study was conducted in Shri Shankaracharya Institute of Medical Sciences, Junwani, Bhilai Chhattisgarh over a period of six months from January 2019 to July 2019. Patients with compound fracture, chronic osteomyelitis, infected nonunion, infected implant removal are not included in the study. Only clean patients like closed fracture, severe osteoarthritis knee, avascular necrosis hip with or without secondary osteoarthritis, prolaps intervertebral disc, cyst in large joint with or without intra-articular extension has been studied for the post-operative outcome following pre-surgical skin preparation using PVP-I.

Composition of 10% povidone-iodine

Povidone-iodine IP 10% w/v: (1.0% w/v available iodine and 2.0% purified water IP quantity sufficient).

Composition of surgical scrub

Povidone-iodine IP 7.5% w/v: (0.75% w/v available iodine) and non-ionic detergent base quantity sufficient.

All patients were undergone allergy test or sensitivity test for PVP-I were advised to clean the affected limb or take bath before surgery whenever possible.

The 2 step skin preparation was used. The area to be operated is shaved, wet with normal saline and then PVP-I surgical scrub 7.5% 5-10 ml is applied on the skin and thoroughly scrubbed using normal saline for 5 minutes till copious suds develops. The scrub is washed away with normal saline or rinse off with sterile gauze soaked in normal saline. The area is then painted as earlier with 10% PVP-I solution over the site to be operated on and over whole limb if fracture is in the limb.[13,14] The paint is kept for at least 10 minutes or till it get dried before incision.

All postoperative patients were given intravenous antibiotics for at least three days. Dressing was done on second postoperative day then on fifth day using 10% PVP-I solution depending on condition of wound or soakage from operated site. Patient was kept on regular follow up depending on the condition of wound, area operated and type of implant used. Microsoft excel has been used as a software tool to analyze the data.

RESULTS

One hundred and forty two patients were studied. The age group the patients was between nine years to eighty years. Out of one hundred and forty two patients, 107 were male and 35 were female. In this study all 142 patients were clean case (non-infective) that under-went surgery; 107 were male and 35 female. In the group, 99 were fracture patients, 15 joint replacement, 11 implant removal, 08 soft tissue procedures, 04 spine surgeries, 04 anterior cruciate ligament reconstruction, and 01 patient was having excision biopsy leg tumor as shown in Table 1.

The patients with closed fracture were 99. Out of these, 03 patients got infected but all 03 patients recovered from the infection. The infection percentage in this group was 3.03%. One patient with spine surgery developed serous discharge but she recovered before stitch removal. Out of 05 infected patients, 03 were male and 02 were female. About 3.52% was the infection rate noted in this study (Figure 1).

Table 1: Number of patients with diagnosis and infection.

Diagnosis	No. of patients	Infection
Closed fractures	99	03
Total hip and knee replacement	15	00
Implant removal	11	00
Soft tissue procedure	08	01
PIVD	04	01
ACL reconstruction	04	00
Bone tumor	01	00

PIVD: prolapsed intervertebral disc; ACL: anterior cruciate ligament.

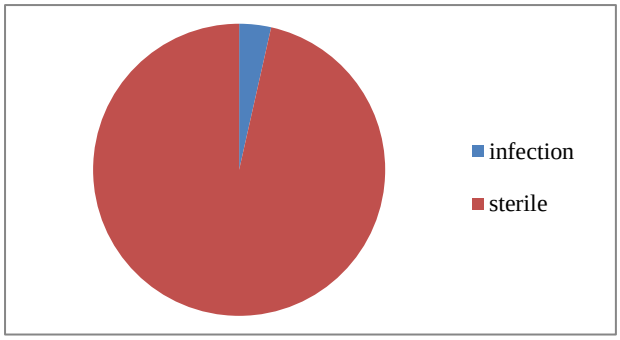

Figure 1: Infection rate.

DISCUSSION

All the patients in the study tolerated the PVP-I very well and none of the patient showed any signs of allergy. PVP-I seems to be the effective antimicrobial agent for surgical site skin preparation. In this study the infection rate was 3.52 %, which is comparable to the study done at university of Virginia Heath System.[15] PVP-I can be used as ointment or as solution for dressing postoperative wound because no organisms have shown to develop resistant to it.

CONCLUSION

Since iodine is discovered, continuous research has been done over it to increase the effectiveness and decrease its toxicity. The infection rate following the use of PVP-I is comparable with that of 2% chlorhexidine and 70% isopropyl alcohol. Henceforth it is safe, effective and cheap alternative that can be used for pre-operative skin preparation and wound dressings.

ACKNOWLEDGEMENTS

I acknowledge the immense help I got from the articles of the scholars whose articles has been cited and included in the reference of this manuscript. I am grateful to the authors, editors and the publishers of all those articles, journals and books from where the literature of my article has been reviewed and discussed. I declare that all the funding to write this manuscript has been done solely and exclusively by me.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the institutional ethics committee

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Cite this article as: Kumar N. A study showing effectiveness of surgical site skin preparation, with two step use of povidone-iodine and postoperative out come in orthopaedic patients. Int J Res Orthop 2019;5:1065-8.