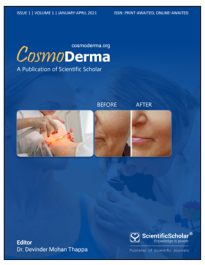
www.cosmoderma.org

ScientificScholar®
Knowledge is power
Publisher of Scientific Journals

CosmoDerma



Focus

Povidone-iodine in dermatology: A reappraisal

Namrata Chhabra

Department of Dermatology, All India Institute of Medical Sciences, Raipur, Chhattisgarh, India.

***Corresponding author:**
Namrata Chhabra,
Department of Dermatology,
All India Institute of Medical
Sciences, Raipur,
Chhattisgarh, India.

chhabra.namrata@gmail.com

Received : 28 June 2021
Accepted : 11 September 2021
Published : 01 October 2021

DOI
10.25259/CSDM_30_2021

Quick Response Code:

INTRODUCTION

In the present era of rapidly increasing antibiotic and antiseptic resistant strains of microbes worldwide, there is a need to explore and recollect more "traditional" methods of combating and preventing infections. This article recalls the importance of Povidone-iodine, an old antiseptic in retrospect as per the evidence and tries to shed some light on its future perspective in dermatology.

Medicinal iodine has evolved from the toxic, unstable, insoluble form first described over a 100 years ago into the well-known iodophor preparation of highly effective antimicrobial known as povidone-iodine (PVP-I) or "Betadine". Iodophors are complexes of iodine and a solubilizing agent, which acts as a reservoir of the active "free" iodine. Iodine was detoxified by binding it to macromolecules to form PVP-I by Shelanski and Shelanski in 1956.[1]

PHARMACOLOGY

PVP-I is a stable chemical complex of triiodide (I^3-) and the organic polymer polyvinylpyrrolidone, improving the chemical stability, solubility, and cutaneous tolerance of active free iodine. PVP-I allows to deliver higher effective concentrations of iodine safely to target tissues without local toxicity.

The polyvinylpyrrolidone component of PVP-I delivers iodine directly to the cell surface of microorganism; the free iodine penetrates the cell wall and targets nucleotides, proteins, and fatty acids, leading to the destruction of the cell.[2,3] In contrast to various antibiotics that act only on the cell walls, PVP-I also effectively inhibits the release of pathogenic factors, such as exotoxins, endotoxins, and tissue-destroying enzymes.[4]

The concentration of free iodine contributes to the bactericidal activity of PVP-I. The free iodine concentration increases with increasing dilutions of PVP-I: dilution weakens the iodine linkage to the carrier, increasing the availability of free iodine in the solution.[3] This process might explain the paradoxical increase in the bactericidal action on increasing the dilution of PVP-I (0.1–1% solution has been proven to be more rapidly microbicidal than the 10% solution).[3]

PVP-I has the broadest spectrum of antimicrobial activity of the available antiseptics, including bacteria (gram-positive and gram-negative), spores, viruses, fungi, and protozoans [Table 1]. It

Table 1: Microbicidal spectrum of PVP-I.

Gram negative bacteria	Gram-positive bacteria
Aerobacter aerogenes	*Bacillus* sp.
Bacteroides sp.	*Clostridium* sp.
Citrobacter sp.	*Corynebacterium* sp.
Edwardsiella sp.	*Diplococcus pneumonia*
Escherichia coli	*Diphtheroides* sp.
Haemophilus sp.	*Micrococcus flavus*
Herellea sp.	*Sarcina lutea*
Klebsiella sp.	*Staphylococcus* sp.
Mimea polymorpha	*Streptococcus* sp.
Neisseria gonorrhoeae	***Acid-fast bacteria***
Proteus sp.	*Mycobacterium* sp.
Pesudomonas sp.	
Salmonella sp.	
Serratia sp.	
Shigella sp.	
Viruses	**Yeasts and other fungi**
Influenza virus	*Aspergillus* sp.
Poliomyelitis virus	*Candida* sp.
Herpes virus	*Cryptococcus neoformans*
Vaccinia virus	*Epidermophyton floccosum*
Rubella virus	*Microsporum audouinii*
HIV	*Nocardia* sp.
Treponema	**Protozoans**
Treponema pallidum	*Entamoeba histolytica*
	Trichomonas vaginalis

PVP-I: Povidone-iodine

has no known acquired/cross-resistance and can penetrate biofilms.

PVP-I is used as various formulations in Dermatology [Table 2]. In the Asian region, the most widely used formulation is the 10% aqueous/alcoholic solution. PVP-I is also available as 10% ointment, 7.5% surgical scrub, and 2.5% dry powder spray. The commonly used 10% Betadine solution delivers about 1% of free molecular iodine. Recently, a preparation of liposomal PVP-I hydrogel has been developed with a unique mode of action, having the antiseptic and anti-inflammatory properties of PVP-I combined with the targeted drug delivery and moisturizing properties of liposomes.

USES IN DERMATOLOGY [TABLE 2]

Disinfection of skin, mucosa, and hands

PVP-I is used mainly for surgical preparation as it has been identified as a broad spectrum, resistance-free biocidal agent. 1% PVP-I has also proven effective as a preprocedural oral mucosal antibacterial agent.[5] Although PVP-I acts against various microorganisms, its use is primarily confined to skin asepsis in dermatology.

Table 2: Formulations of PVP-I used in dermatology.

Indication of use	Formulation and concentration of PVP-I
Pre and postoperative skin antisepsis	10% solution
Wound management, chronic venous ulcer	10% solution/10% ointment/5% cream
Infections of skin- onychomycosis, verruca vulgaris, chemotherapy-associated paronychia granulation tissue, molluscum contagiosum	Compounded 1% PVP-I solution in a Dimethylsulfoxide vehicle

PVP-I: Povidone-iodine

Wound management

Diluted PVP-I has been used in postoperative wound care as well as chronic, non-healing wounds in order to reduce bacterial colonization. However, due to its cytotoxic effect, PVP-I may result in the desiccation of chronic wounds.[6] Therefore, Iodine wound dressings are recommended for exudative wounds, including leg ulcers, and are not appropriate in treating autoimmune bullous disease as it can inhibit wound healing.

To overcome this limitation, a formulation of 3% PVP-I liposome hydrogel has been developed to improve drug delivery and create a moisturizing wound environment, thus promote epithelialization of chronic wound beds.[7] Liposomal formulation has shown better antibacterial efficacy and re-epithelialization of wounds compared to chlorhexidine gauze.

Treatment of cutaneous infections

Compounded 1% PVP-I solution in dimethylsulfoxide (DMSO) vehicle is effective in onychomycosis, verruca vulgaris, granulation tissue, and chemotherapy-associated paronychia. DMSO facilitates diffusion of PVP-I through the stratum corneum, triggers the formation of drug deposition in the dermis, and promotes transport into local blood vessels.[8] This combination has also been found to be effective in the treatment of molluscum contagiosum.[9] However, it is not commercially available yet.

One pilot study has shown the potential utility of liposomal PVP-iodine hydrogel as an effective treatment for inflammatory skin conditions associated with bacterial colonization such as acne, rosacea, impetigo, and atopic dermatitis with relatively better skin tolerance.[10] The relative safety in terms of local side effects in this study may be because of low concentrations of PVP-iodine (3%) in liposomal formulation.

Chronic venous ulcer

PVP-I has been shown to reduce bacterial load, decrease infection rates and promote chronic venous ulcer healing (evidence level C).[11,12]

Miscellaneous uses

PVP-I is commonly used for neutralization of phenol in phenol matricectomy for the treatment of ingrown toenail.[13]

ADVERSE EFFECTS

PVP-I has good skin tolerance with minimal side effects. However, there are few case reports of immediate or delayed allergic reactions to PVP-I, with povidone or nonoxynol as the most likely sensitizing agents [Figure 1].[14,15] Hence, caution should be taken while using PVP-I in patients with a history of allergy to iodine products. Systemic toxicity is a rare occurrence with PVP-I. Systemic absorption due to the application of PVP-I over large surface area wounds may be a concern. PVP-I are both renally excreted; therefore toxicity has been reported commonly in a setting of renal impairment.[16] Major systemic adverse effects include metabolic acidosis, cardiovascular instability (hypotension and bradycardia), renal failure, leukocytoclastic vasculitis, hyperthyroidism, and abnormal liver function. Other rare side effects include iodine acne, runny nose, conjunctivitis, gastroenteritis, bronchitis, parotid swelling.[17] Iododerma due to systemic absorption from topical iodine use is extremely rare, with a few cases reported. It is essential to differentiate toxic reactions to the inappropriate use of PVP-I from actual allergic reactions. In case of toxic effects of PVP-I, it can still be used with a change in the concentration and method of application. On the contrary, if there is an actual allergic reaction to PVP-I or its additives, proven by prick tests if immediate or patch tests if delayed-type, the PVP-I or the offending additives must be avoided under all circumstances.

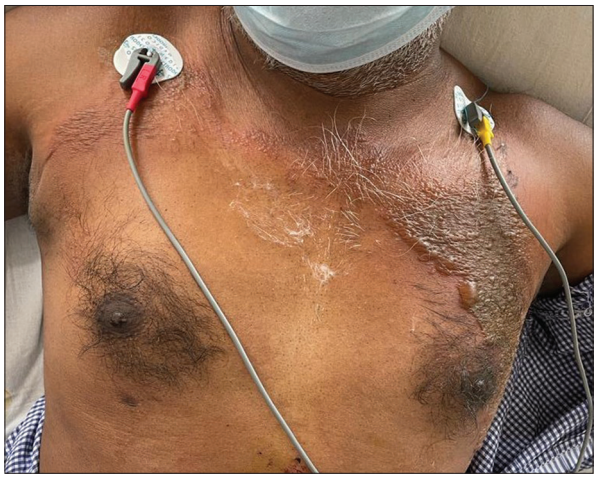


Figure 1: Irritant contact dermatitis secondary to povidone-iodine applied over chest for preoperative skin antisepsis.

CONTRAINDICATIONS AND PRECAUTIONS

PVP-I is contraindicated in patients with a proven allergy to PVP-I or its additives and hyperthyroidism/thyroid cancer. It should be used with caution in pregnant, lactating women and infants. The use of PVP-I in children with a higher skin surface area per body weight and less developed skin barrier may lead to increased penetration and systemic absorption, so it should be done carefully.

CONCLUSION AND FUTURE PERSPECTIVES

PVP-I is a highly effective antimicrobial with a broad spectrum of activity and no known resistance. In addition, it is a cost-effective and readily available antiseptic and disinfectant. The side effects are minimal, however, cytotoxicity and local allergy should be taken into consideration. The liposomal formulation has been developed to optimize the use of PVP-I for particular areas and indications, with better efficacy and tolerance. With these advancements and emerging indications, PVP-I is poised to enter a renaissance in dermatology.

Declaration of patient consent

Patient's consent not required as there are no patients in this study.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflict of interest.

REFERENCES

1. Shelanski HA, Shelanski MV. PVP-iodine: History, toxicity and therapeutic uses. J Int Coll Surg 1956;25:727-34.
2. Sibbald R, Leaper D, Queen D. Iodine made easy. Wounds Int 2011;2:1-6.
3. Selvaggi G, Monstrey S, Van Landuyt K, Hamdi M, Blondeel P. The role of iodine in antisepsis and wound management: A reappraisal. Acta Chir Belg 2003;103:241-7.
4. König B, Reimer K, Fleischer W, König, W. Effects of betaisodona on parameters of host defense. Dermatology 1997;195:42-8.
5. Domingo MA, Farrales MS, Loya RM, Pura MA, Uy H. The effect of 1% povidone iodine as a pre-procedural mouthrinse in 20 patients with varying degrees of oral hygiene. J Philipp Dent Assoc 1996;48:31-8.

6. Goldenheim PD. An appraisal of povidone-iodine and wound healing. Postgrad Med J 1993;69:S97-105.
7. Vogt PM, Reimer K, Hauser J, Rossbach O, Steinau HU, Bosse B, *et al*. PVP-iodine in hydrosomes and hydrogel-a novel concept in wound therapy leads to enhanced epithelialization and reduced loss of skin grafts. Burns 2006;32:698-705.
8. Capriotti K, Capriotti JA. Topical iodophor preparations: Chemistry, microbiology, and clinical utility. Dermatol Online J 2012;18:1.
9. Capriotti K, Stewart K, Pelletier J, Capriotti J. Molluscum contagiosum viral infection treated with a dilute povidone-iodine/dimethylsulfoxide preparation. Dermatol Ther (Heidelb) 2016;6:101-3.
10. Augustin M, Goepel L, Jacobi A, Bosse B, Mueller S, Hopp M. Efficacy and tolerability of liposomal polyvinylpyrrolidone-iodine hydrogel for the localized treatment of chronic infective, inflammatory, dermatoses: An uncontrolled pilot study. Clin Cosmet Investig Dermatol 2017;10:373-84.
11. Fumal I, Braham C, Paquet P, Piérard-Franchimont C, Piérard GE. The beneficial toxicity paradox of antimicrobials in leg ulcer healing impaired by a polymicrobial flora: A proof-of-concept study. Dermatology 2002;204:70-4.
12. Moore K, Thomas A, Harding KG. Iodine released from the wound dressing Iodosorb modulates the secretion of cytokines by human macrophages responding to bacterial lipopolysaccharide. Int J Biochem Cell Biol 1997;29:163-71.
13. Khunger N, Kandhari R. Ingrown toenails. Indian J Dermatol Venereol Leprol 2012;78:279-89.
14. Dewachter P, Mouton-Faivre C. Allergy to iodinated drugs and to foods rich in iodine: Iodine is not the allergenic determinant (in French). Presse Med 2015;44:1136-45.
15. Dooms-Goossens A, Deveylder H, de Alam AG, Lachapelle JM, Tennstedt D, Degreef H. Contact sensitivity to nonoxynols as a cause of intolerance to antiseptic preparations. J Am Acad Dermatol 1989;21:723-7.
16. Rath T, Meissl G. Induction of hyperthyroidism in burn patients treated topically with povidone-iodine. Burns Incl Therm Inj 1988;14:320-2.
17. Below H, Brauer VF, Kramer A. Iodresorption bei antiseptischer anwendung von iodophoren und schlussfolgerungen zur risikobewertung. GMS Krankenhaushyg Interdiszip 2007;2:41.

How to cite this article: Chhabra N. Povidone-iodine in dermatology: A reappraisal. CosmoDerma 2021;1:51.