Review Article

JRAD Journal of Research and Advancement in Dentistry

J Res Adv Dent 2017;6:1s:20-24.

Povidone Iodine Revisited: A Review

Sindhura H[1*] Shilpa RH[2] Harsha RH[3] Savitha AN[4]

[1]Senior Lecturer, Department of Periodontology and Oral Implantology, Navodaya Dental College & Hospital, Raichur, Karnataka, India.
[2]Senior Lecturer, Department of Oral and Maxillofacial Surgery, Navodaya Dental College & Hospital, Raichur, Karnataka, India.
[3]Reader, Department of Prosthodontics, Navodaya Dental College & Hospital, Raichur, Karnataka, India.
[4]Professor, Department of Periodontology and Oral Implantology, The Oxford Dental College & Reasearch Centre, Bangalore, Karnataka, India.

ABSTRACT

Background: Iodine is an antiseptic that has been used in wound care for more than 150 years. Traditional formulations of iodine had serious limitations that were reduced in later products. Over the last century, a number of iodine compounds and preparations have developed to overcome the adverse side effects of iodine. New formulations appear to keep the same clinical efficacy, avoiding the problem of toxicity. Povidone Iodine or polyvinyl pyrrolidone-iodine is an iodophor and a broad spectrum antimicrobial agent. It is highly soluble and less toxic making it widely suitable. In dentistry it is used for pre surgical skin preparation, pre procedural rinse to reduce bacteraemia and microbial load in aerosols, root canal irrigant and intracanal medicament. We mainly focused our review on the role of the newly developed formulations of iodine preparations – povidone iodine, its antimicrobial activity, its clinical applications and the wound healing process.

Keywords: Povidone Iodine, Iodophor, Antiseptics, Periodontal therapy.

INTRODUCTION

Iodine, a non-metallic essential element discovered in 1812 by the French scientist Courtois, and was named by Gay Lussac in 1814 after the Greek word meaning violet, which is the colour of iodine vapour. During Napoleon's Egyptian campaign, wounded soldiers were treated with the extracts from the plants enriched with iodine and also was used as a disinfectant during the American Civil War. [1, 2]

Iodine was officially recognized by the pharmacopoeia of the United States in 1830, specifically as tincture iodine. The first specific reference to the use of iodine in wounds was made in 1839 by Davies and the first fundamental papers with a scientific basis about the efficacy of iodine were published from 1874 to 1881 by Davaine. In 1874, he found iodine to be one of the most efficacious antiseptics. On the basis of Davaine experiment, Koch experimented with iodine against anthrax spores and his literature proved to be success against the anthrax spores. [3]

Iodine is one of the most popular groups of antiseptics used in hospitals for skin, mucous membrane disinfection prior to surgery, cleansing open wounds, adjunctive burn treatment, operative wound infection antisepsis and treatment of vaginitis. Thus iodine has shown promising results in the field of medicine. Despite the successes that have been achieved with iodine, it was ascertained that it possesses certain properties unsuitable for practical application. Goebel (1906) referred iodine's unpleasant odour, staining the skin as an intense yellowish brown and causes blue stains in the presence of other metals. Furthermore, in solution form it is not stable, irritates the tissue and may cause allergic reaction. To avoid these incompatibilities without a significant loss of bactericidal effect iodophors forms were the first

Received: Oct. 7, 2016: **Accepted:** Dec. 12, 2016
*Correspondence Dr. Sindhura H.
Department of Periodontology and Oral Implantology, Navodaya Dental College & Hospital, Raichur, Karnataka, India.
Email: sindhurah@gmail.com

pISSN 2278-0076
eISSN 2321-9270

such compounds to decrease the above mentioned limitations and largely to achieve the goal.

Iodophors are the iodine carrier. The two most important iodophors used currently are Povidone-iodine and cadexomer-iodine. Povidone iodine is a complex of iodine with a carrier that has three important functions:

- To increase the solubility of iodine
- To provide a sustain release reservoir of halogen.
- To reduce the equilibrium concentration of free molecular iodine.

The carriers are the neutral poly vinyl pyrrolodinone, polyvinyl alcohols polyamide, poly ether glycols. Iodophors exert an excellent antimicrobial activity against bacteria, yeasts, viruses and protozoans with virtually no evidence of resistance development. The best-known and most widely used iodophors is Povidone–iodine (BetadineA, Purdue Frederich Company, Norwalk).

Povidone-iodine (PVP-I) is formed by binding free iodine to polyvinyl-pyrrolidone (PVP), a solubilising agent. This is done to decrease the toxicity of the iodine and the iodine in PVP Iodine has virtually no vapour pressure hence no iodine loss occurs and there is no significant odour. As iodine is liberated from the PVP molecule it exerts its antimicrobial effect. In addition, it maintains its germicidal activity in the presence of blood, pus, serum, and necrotic tissue. Povidone iodine meets all of the criteria for the ideal antiseptic.

One hypothesis states that the concentration of "free" iodine (i.e., the elemental iodine in solution) significantly contributes to the bactericidal activity of Povidone iodine solution. Trueman et al as stated that dilution of Povidone-iodine results in weakening of the iodine linkage to the carrier polymer with a concomitant increase in the amount of elemental (free) iodine in solution. According to the study of Gocke et al. (1985), the bactericidal action of PVP-I increases with decreasing concentration, in other words with the dilution of the product would decrease the linkage between iodine and polyvinylpyrrolidone thus increasing free iodine. Therefore that PVP-I is effective at the weakest concentration on periodontopathogenic species. [4, 5] It seems therefore that PVP-I is effective at the weakest concentration on periodontopathogenic species (bactericidal minimal concentration) with regard to chlorhexidine, sodium fluoride and tin fluoride.

MECHANISM OF ACTION

The antibacterial activity of Povidone iodine is due to oxidation of amino (NH), Thiol (SH^-) and phenolic hydroxyl (OH^-) groups in amino acids and nucleotides. It also reacts with unsaturated fatty acids in cell walls and organelles membranes. The microbicidal action of Povidone iodine is related to the non complexed freely mobile elemental iodine I_2, the active form of which is polarized by water and can be considered to be H_20I^+ in its final state. This activated iodine reacts in electrophilic reactions with enzymes of the respiratory chain as well as with amino acids of the cell membrane proteins both located in the cell wall. As a result, the well balanced tertiary structure necessary for maintaining the respiratory chain is destroyed and the microorganism irreversibly damaged. It interacts with cell wall causing transient or permanent pore formation resulting in loss of cytoplasmic material and deactivation of enzymes due to direct contact with iodine. Because it adversely affects multiple bacterial sites, the effect of PVP-iodine occurs relatively quickly, decreasing the need for extended exposure time. [6, 7]

ANTIVIRAL ACTIVITY

Virus infection can be inhibited by the use of compounds that bind to viral HA or inhibit NA activity or inhibit both HA and NA activities, which are the surface glycoproteins hemagglutinin (HA) and neuraminidase (NA). PVP-I products have been found to be effective in inactivating a variety of enveloped and non-enveloped viruses, such as polio, herpes simplex, herpes zoster, and human immunodeficiency viruses. Anti-influenza virus activity of PVP-I also has been reported recently. [8]

As Skin Disinfectant:

The patient's skin is a major source of pathogens that cause infection. Traditional aqueous-based iodophors, such as Povidone-iodine, are one of the few products that can be safely used on mucous membrane surfaces. PVP-I as 10%

solution (1% available iodine) is widely used for skin disinfection and 7.5% PVP-Iodine solution (0.75% available iodine) is used for wound cleansing which reduces the bacterial count by 98 per cent.

Pre-procedural Rinse:

The American Heart Association suggests that patients at risk for bacterial endocarditis use an antimicrobial mouth rinse before dental treatment. The most recently published guidelines of the American Heart Association (AHA) recommend the use of topical antimicrobials such as Povidone–iodine (PVP–I) as an adjunct to systemic antibiotic cover to enhance the efficiency of current prophylactic measures (Dajani et al. 1997). Hence pre-procedural rinse with povidone iodine reduces the level of oral microorganisms generated in aerosols routine dental procedures. [9] Cherry M found that rinsing with 7.5% POV–I for 2 min before ultrasonic scaling significantly reduced the incidence of odontogenic bacteraemia from 33% to 10% in plaque-induced gingivitis trial. [10] Povidone-iodine can be used as an irrigant for the alveolar sockets following dental extractions as haemostatic agent, as this iodine is corrosive due to its oxidizing potential while povidone is a thickening and granulating agent; together they have a chemo cauterizing effect that could be the reason for the cessation of bleeding. [11]

Yamalik et al showed the effect of local irrigation following dental procedures, with three different antiseptic solutions including hydrogen peroxide, chlorhexidine and povidone iodine, on the frequency of bacteraemia after tooth extraction. Povidone iodine was the most effective, when compared to hydrogen peroxide, chlorhexidine group. [12] Yoneda et al evaluated the effect of povidone iodine to treat oral bacteria and mucositis, in oesophageal cancer patients undergoing chemotherapy in a special oral care group. The incidence of the oral mucositis was significantly reduced in the special oral care group than the control group. [13]

CLINICAL APPLICATIONS IN PERIODONTOLOGY

Rosling et al. first documented the therapeutic potential of adjunctive local antimicrobial agents in a controlled clinical trial over a 12-month post-treatment period with probing depths of 7 mm. At 12 months, gains in clinical periodontal attachment with local antimicrobial therapy in deep sites were nearly twice those recorded following conventional periodontal debridement. [14]

Hoang et al. (2003) showed the clinical and microbiological effect of PVP-I in sub-gingival irrigation in advanced periodontal lesions (pocket depth ≥ 6 mm). The results showed that, at 5 weeks post-treatment, sub-gingival irrigation with PVP-I associated to SRP caused a reduced total number of periodontal pathogens as well as decreased pocket depths more significantly than SRP alone.[15]

Rosling et al. and Christenson et al. showed a gain in clinical attachment after ultrasonic root debridement with a diluted 0.05% povidone-iodine solution than with physiological saline. The enhanced healing appeared to be due to a better suppression of sub gingival periodontal pathogens.[16]

A controlled clinical trial was performed in thirty-two patients with probing pocket depth more 5 mm with class II interproximal furcation. Six months after treatment, the test group showed statistically significant outcome with the use of PVP-I as an adjunct in the non-surgical treatment of interproximal class II furcation. [17]

Kotsilkov et al showed the significant reduction in bleeding on probing than the SRP alone using sub gingival irrigation with 10% povidone-iodine solution with more than 5mm of periodontal pocket. [18]

EFFECT OF POVIDONE IODINE ON HEALING PROCESS

Data from Moore et al demonstrated that the delivery of iodine to non-active macrophages within the chronic wound may induce TNF a as a primary event. As a consequence, iodine induces a fresh influx of macrophages and T helper cells, which are considered to play a positive role in modulating wound healing. PVP-I also act as an antiedematous agent due to its inhibitory effect of leukotriene B4 and leukocyte extravasations (chemotaxis). [19] It also decrease the activity of

cytochrome oxidase there by altering the prostaglandin synthesis. [20] Hence it plays a positive role in the healing process.

CONCLUSION

Povidone iodine can be used as an adjunct to SRP that favourers the non-surgical periodontal therapy, due to its broad-spectrum antimicrobial activity, low potential for developing resistance, fewer adverse reactions, wide availability, ease of use and low financial cost. It plays a positive role in modulating wound healing and reducing the inflammation and has also shown to reduce the periodontal pathogens. Hence, the use of chemotherapeutic as an adjunct to SRP has shown significant results clinically as well as microbiologically.

Thus, Povidone iodine can be used as an adjunct to SRP in gingivitis and periodontitis patients with acutely inflamed soft tissue, in aesthetic areas, in unfavourable anatomical considerations and also in patients in whom surgical therapy is contraindicated, like in medically comprised patients. Therefore, considering the above mentioned facts, it can be concluded that PVP-I can improve the success of non-surgical periodontal therapy. Therefore, in lieu of all the above mentioned facts, Povidone iodine could be considered as an adjunctive treatment approach in the treatment of chronic and aggressive periodontitis.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

REFERENCES

1. Cooper RA. Iodine revisited. Int Wound J 2007 Jun; 4: 124-37.

2. Gershenfeld L. Povidone-iodine as a topical antiseptic. Am J Surg 1957; 94: 938-9.

3. Brenes RA, Ajemian MS, Macaron SH, Panait L, Dudrick SJ. Initial experience using a hyaluronate-iodine complex for wound healing. Am J Surg 2011; 77: 355-9.

4. Berkelman RL, Holland BW, Anderson RL. Increased bactericidal activity of dilute preparations of povidone-iodine solutions. J Clin Microbiol 1982; 15: 635-9.

5. Gocke DJ, Ponticas S, Pollack W. In vitro studies of the killing of clinical isolates by povidone-iodine solutions. J Hosp Infect 1985; 6: 59-66.

6. Quirynen M, Teughels W, De Soete M, Van Steenberghe D. Topical antiseptics and antibiotics in the initial therapy of chronic adult periodontitis: microbiological aspects. Periodontol 2000 2002; 28: 72-90.

7. Walker CB, Karpinia K, Baehni P. Chemotherapeutics: antibiotics and other antimicrobials. Periodontol 2000 2004; 36: 146-65.

8. Sriwilaijaroen N, Wilairat P, Hiramatsu H, Takahashi T, SuzukiT, ItoMetal.Mechanisms action of povi doneiodine against human and avian influenza viruses:its effects hemagglutination and sialidas e activities. Virol J 2009; 13; 6: 124.

9. Ramesh A, Jayasheela V, Thomas B, Shetty V. Effect of povidone-iodine mouth rinsing on post-scaling bacteraemia - A microbiological study. Clini Dent 2010; 1: 5-7.

10. Cherry M, Daly CG, Mitchell D, Highfield J. Effect of rinsing with povidone-iodine on bacteraemia due to scaling: a randomized-controlled trial. J Clin Periodontol 2007; 34: 148-55.

11. Al-Amir AQL. Evaluation of the haemostatic action of povidone- iodine in dental extraction. Clinical and follow up prospective study. J Bagh Coll Dentistry 2012; 24: 85-87.

12. Yamalik MK, Yucetas S, Abbasoglu U. Effects of various antiseptics on bacteremia following tooth extraction. J Nihon Univ Sch Dent. 1992; 34: 28-33.

13. Yoneda S, Imai S, Hanada N, Yamazaki T, Senpuku H, Ota Y et al.Effects of oral care on development of oral mucositis and microorganisms in patients with esophageal cancer. J Infect Dis 2007; 60: 23-8.

14. Rosling BG, Slots J, Webber RL, Christersson LA, Genco RJ. Microbiological and clinical effects of topical sub gingival antimicrobial treatment on human periodontal disease. J Clin Periodontol 1983; 10: 487-514.

15. Hoang T, Jorgensen MG, Keim RG, Pattison AM, Slots J. Povidone-iodine as a periodontal pocket disinfectant. J Periodont Res 2003; 38; 311–17.

16. Christersson LA, Rosling BG, Dunford RG, Wikesjo UM, Zamhon JJ, Genco RJ. Monitoring of sub gingival Bacteroides gingivalis and Actinobacillus actinomyceterncomitans in the management of advanced periodontitis. Adv Dent Res 1988; 2: 382-388.

17. Khosropanah H, Koohpeima F, Ieal F, Kiani Yazdi F. The Clinical Effectiveness of Subgingival Irrigation with Povidone-Iodine and Hydrogen Peroxide in Treatment of Moderate to Severe Chronic Periodontitis. J Dent Shiraz Univ Med Scien 2012; 13: 44-48.

18. Kotsilkkov K, Emilov D, Popova C. Subgingival irrigations with povidone-iodine as adjunctive treatment of chronic periodontitis. J of IMAB-Annual Proceeding (Scientific Papers) 2009, book 2: 84-88.

19. Arakeri G, Brenann PA. Povidone iodine as an anti-oedematous agent? Int J Oral Maxillofac Surg 2011; 40; 173-76.

20. Senthil K, Vinay K, Gayathri N, Rajesh P. Role of povidone iodine in peri apical surgeries hemostyptic and anti-inflammatory? Ann Maxillofac Surg 2011; 1: 107-11.