

Photodynamic Therapy (PDT) and its treatment effects on Oral Lichen Planus

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Abstract

Photodynamic therapy is a light based therapy used to ablate tumours .Aphotosensitizing agent is used and activated by a specific wave length of light in presence of oxygen, which in turn leads to creation of photodynamic reaction. This article provides comprehensive review on OLP , its etiology , clinical features and recent non pharmacological treatments. Recently , the use of photodynamic therapy is expanding as its safe , non invasive and convenient.

Keywords: Oral lichen planus; Photodynamic therapy; sensitisation; chemotherapy ; visual analogues scale;Treatment

HISTORY

Photodynamic therapy was discovered hundred years ago by a medical student Oscar Raab. Raab found that Intense light applied to dye resulted in the destruction of microorganisms.

It was not until the 1970s when Dougherty working with porphyrin compound accidentally discovered photodynamic therapy. He created a commercially suitable photosensitizing drugs and appropriate clinical trials proving the value of photodynamic therapy to oncology. Hence he is known as father of photodynamic therapy.

INTRODUCTION

Oral premalignant lesions have high potential for malignant transformation. The use of a conservative and effective treatment modality is the best strategy for cancer prevention. PDT is a non-invasive method for topical and selective treatment of oral precancerous lesions. PDT is an effective treatment modality of OLP, OL and initial stages of head and neck cancer. It is also used in treatment of erythroleukoplakia, dysplasia (mild to moderate) and mucosal hypertrophy.¹

MECHANISM OF PHOTODYNAMIC THERAPY

Photodynamic therapy mediates destruction of lesion by three possible mechanisms in vivo which includes cellular, vascular and immunological mechanisms. Firstly destruction of lesion by reactive oxygen species (ROS) (cellular effects). Secondly vascular destruction of the lesion leading to thrombus formation followed by infarction of tumour (vascular effect). Thirdly activation of immune response against malignant cells.

MECHANISM OF ACTION

In the clinical situation application of photodynamic therapy is translated into 2 step procedure. The first step is through sensitization: A presensitization is administered clinically by IV injection or topically. Secondly by illumination: the presensitized tissue is

exposed to a specific light whose wavelength matches in the absorption band of chemical or drug. The ensuing PDR is presented as necrotic destruction of the tissue under treatment.²

PHOTOSENSITIZING AGENT

Photosensitizing agents are natural or synthetic structures that transfer light energy. In the clinic, a successful photosensitizing agent has the following characteristics. Non-toxic till activated, hydrophilic for easy systemic application, activated by a clinically useful light wavelength. Can be categorised into 3 types based on origin and chemical structures

1. Porphyrin based
2. Chlorophyll based
3. Dyes

Most approved and in current clinical usage is porphyrin group

1. Hematoporphyrin derivative (HPD):
HPD (photofrin; Axcan Parma/Pinnacle Inc; Mont-Saint-Hillier, Canada) was the first commercially available drug.
2. M-tetrahydroxyphenyl Chlorine (mTHPC) (Foscan)
3. Mono-L-aspartyl chlorine e6 (NPe6); marketed under different names such as MACE, LSII, NPe6, this derivative is also called as photolon
4. Aminolevulinic acid (ALA)
5. Photosens²

ILLUMINATION

Each PS has a unique wavelength of light and intensity of light fluence for successful activation. Some PS may activate a higher wavelength for deeper penetration. ALA, HPD, MACE and FOSCAN activate at multiple light wavelengths from Blue to Green to red allowing for more selective illumination depth. As long as light of appropriate wavelength and fluence activate the PS, successful PDT can occur

ILLUMINATION SOURCE

- 1) LASERS (LLLT)
- 2) Lamps (Metal halogen lamps and xenon arc lamps)
- 3) LED³

CLINICAL APPLICATION

Clinical evaluation of OLP

Materials used:

- 1 5 ALA photosensitizer
2. Light emitting diode (LED) light (blue light of wavelength 420nm)

Procedure: The lesion were cleaned with cotton wool soaked in a soap free cleansing lotion, before application of photosensitizer. 5 - ALA was used as photosensitizer. 50 mg of 5 - ALA powder was mixed with 1 ml of water yielding a clear colourless solution. This solution applied topically on the lesion except for a margin of 5 - 6 mm around them, 30 minutes prior to exposition with the LED at a wavelength of 420 nm. Patient were instructed to sit for 30 minutes for the incubation period of 5 - ALA. Then lesion and 5 - 6 mm of surrounding area were illuminated with a spot size of 1 cm² for 10 minutes.

For OLP, the response rate was assessed by two measures, (a) scoring symptoms and (b) rate of reduction in size of lesion before and after treatment were assessed by using visual analogue scale (VAS) from 0 - 3 and scaled blade respectively.⁴

CURRENT APPLICATION OF PDT

Effect of PDT, are found to be limited to the superficial epithelial layers while sparing the underlying connective tissues and muscles. The intact sub epithelial collagen and elastic, which are needed for regeneration, promote healing with minimal scarring and excellent functional and cosmetic results.

CLINICAL EVALUATION FOR OLP

- 1) Complete response complete response (CR): Lack of visible lesion confirmed by clinical evaluation.

2) Partial response (PR): At least 20 percentage reduction in size

3) No response (NOR): Less than 20 percentage reduction in size of the lesion

DISCUSSION

Identification and elimination of earliest pre-cancerous stage is the best strategy to prevent the further transformation into malignancy. The survival rate of oral cancer patients remains low although various treatment ways have been used like radical surgical excision, chemotherapy, radiotherapy separately or in combination. The annual rate of malignant transformation in oral epithelial dysplasia, leukoplakia and in OLP is 14%, 43%, and 0.2% respectively. OL is most common premalignant lesion having high potential for malignant transformation. OLP is a chronic mucocutaneous disorder associated with cell mediated immune system dysfunction. A number of clinical forms are recognised, reticular, papular, plaque like erosive and bullous. Treatment is focussed on symptoms alleviation and elimination of mucosa erythema and ulceration photodynamic therapy involving topical or systemic administration of PS drugs following a light irradiation using specific wave length is emerging as a potential treatment. Recent studies demonstrated that topical 5 -ALA mediated PDT is an effective treatment alternative for OL. Based on various studies, PDT is presently considered as an alternative treatment for OL and OLP the use of PDT is expanded as it is numerous benefits, it is safe convenient, non invasive, selective toxicity towards target tissue, healing without scarring. As it does not produce any harm to normal tissue, it can be used alone or in conjunction with other treatment. In light of the evidence available from various retrospective and prospective studies, it is found that PDT offers an exciting approach for the management of OLP as a stand alone modality or as an adjuvant therapy in combination with other therapeutic approaches.⁵

CONCLUSION

PDT possess significant potential in the elimination of premalignant tissue. It is beneficial in treating premalignant lesions such as OL and OLP and as an adjunctive therapy in removal of areas of field cauterization adjacent to the surgical site. The advantage of PDT as compared with surgery, chemotherapy, radiotherapy are reduced long term morbidity and PDT do not compromise future treatment options for the residual or recurrent disease. PDT is considered to be a promising anti tumor strategy. Interdisciplinary uniqueness of PDT inspire specialist in physics, chemistry, biology and medicine and it's further development and novel applications can be only limited by their enormous imagination.

REFERENCE

1. Maloth K N, Velpula N, Kodangal S, Sagamesh M, Vellamchetta K, Urgappa S; Photodynamic therapy - A non-invasive Treatment Modality for Precancerous lesions. J lasers Med SCI. 2016Winter, 7(1):30-36.
2. Allison RR and Moghissi K; PDT (photodynamic therapy):PDT Mechanism. ClintEndosc.2013Jan.
3. Mollaoglu N. Oral lichen planus: a review Br J Oral Maxillofac Surge 2000;38(4)370-377.
4. Bobbio A, Vescovi P, Ampollini L, Rusca M Oral erosive lichen planus regression after thymoma resection Ann Thorax Surge 2007;83(3):1197-1199.
5. Al-Maweri SA, Ashraf S, Kalakonda B, Halboun E, Petro w, Al Aizari N A . Efficacy of PDT in the treatment of symptomatic oral lichen planus a systematic review .J Oral Pathol Med . 2018 Jan 19.doi:10.1111/jop.12684. [Epub ahead of print] Review . Pub Med PMID :29350426