Photodynamic Therapy in the Treatment of the Oral Leukoplakia – Preliminary Report

Terapia fotodynamiczna w leczeniu leukoplakii błony śluzowej jamy ustnej – doniesienie wstępne

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Abstract

Background. Photodynamic therapy is a method of topical and selective destruction of superficial skin and oral mucosa premalignancies.

Objectives. The goal of the study was the assessment of the photodynamic therapy efficacy in oral leukoplakia.

Material and Methods. The research material comprised 20 patients aged 20–27 with histopathologically confirmed multifocal oral leukoplakia. In the treatment, 0.1% chlorophyll gel was topically administered directly on the pathologic lesion 4–5 hours before the irradiation. The radiation waves length was 630 nm and it was generated by Secura PDT laser. The laser strength was 700 mW and the dose 100–200 J/cm². Every 21–30 days, 3–5 procedures were repeated depending on the treatment results and the patient’s reaction.

Results and Conclusions. The total response to the treatment was observed in 16 persons. The obtained therapeutic effects pointed at the high efficacy of the photodynamic therapy in the oral leukoplakia treatment (Dent. Med. Probl. 2004, 41, 2, 225–228).

Key words: photodynamic therapy, oral leukoplakia.

Streszczenie

Wprowadzenie. Terapia fotodynamiczna jest metodą miejscowego i wybiórczego niszczenia powierzchniowych zmian przednowotworowych skóry i błony śluzowej jamy ustnej pod wpływem światła po zastosowaniu fotouczulaczy.

Cel pracy. Ocena skuteczności terapii fotodynamicznej w leukoplakii jamy ustnej.

Materiał i metody. Grupę badaną stanowiło 20 osób w wieku 20–27 lat z potwierdzoną histopatologicznie leukoplakią wieloogniskową jamy ustnej. Jako fotouczulacz zastosowano 0,1% żel chlorofilowy podawany miejscowo na zmianę patologiczną 4–5 godzin przed naświetlaniem. Światło o długości fali 630 nm generował laser Secura PDT. Moc lasera wynosiła 700 mW, dawka 100–200 J/cm². Naświetlania powtarzano 3–5 razy co 21–30 dni w zależności od wyników leczenia i reakcji pacjenta.


Słowa kluczowe: terapia fotodynamiczna, leukoplakia jamy ustnej.
combined use of these two can guarantee the therapeutic effect.

Photosensitizing agent is a chemical compound the structure of which undergoes the changes due to the absorption of energy carried by the light wave. This causes the agent’s toxicity for the cell resulting in its final decay. It should be noted, however, that adequate chemical groups forming the agent’s particle influence its absorption spectrum image. On this image basis the light wavelength should be selected for further irradiation of the pathologic lesion.

Another important feature of the photosensitizing agent is the capability of the preferential penetration of pathologically changed cells. The surveys are carried on to observe mT PEMF-pulsating electromagnetic fields. These surveys suggest that PEMF influence cellular membranes permeability [2]. Due to such a modification (PDT + PEMF), photosensitizing application time can be shortened.

Very often, in the photodynamic therapy, photosensitizing agent precursor is very often used. This precursor, after very many intracellular biochemical changes is turned into a proper photosensitizing agent. At present, such a precursor frequent example is δ-aminolevulinic acid (ALA). Penetrating the cell, ALA is included into the biochemical changes tract resulting in protoporphyrin (PpIX) formation being the appropriate agent. Reduction of pH within the pathologic change area has a positive influence on ALA capture [3]. Local congestion caused by e.g. the temperature local increase has a similar influence on the photosensitizing agent capture [4]. Depending on their structure as well as the tract which they follow after the cell penetration, photosensitizing agents can accumulate in various cellular organelles: mitochondria, lysosomes, endoplasmatic reticulum [5]. The agent intracellular accumulation site is determined by its activity mechanism.

Light is another PDT component mentioned above. There are two different types of light used: coherent (lasers) as well non coherent (lamps with various types of filters or other devices based on LED technology) [6–8]. Length is one of light describing features treating it as electromagnetic waves. There are many PDT modifications referring to the wavelength. At present, visible light almost full spectrum is used, starting with red [9], through green [10, 11], purple [12] and arriving at UV-A [13]. Tissues seem to be the best penetrated with the waves of 600 and 680 nm of length. Hence the conclusion that using the red light in PDT is the best solution [14]. The studies are carried on in order to determine whether the continuous or pulsating type of irradiation is more efficient [15, 16].

PDT is a new method so the activity all mechanisms are not yet recognized. Those which have already been detected are e.g. induction of radicals which on reacting with oxygen form highly reactive compounds (’O₂-, H₂O₂, ’OH). These particles are responsible for the genetic material fragmentation as well as for the cellular membranes damages in reactions with poly non-saturated lipid acids [14]. The photosensitizing agent acts also at the level of the tumor vessels endothelium and causes platelets aggregation leading to the vessels lumen closure [15]. Some photosensitizing agents are able activate the genes responsible for the cell death [17].

Every PDT procedure consists of three stages. At the first stage the agent is applied either to the pathologic lesion or systemically. The next stage is the period during which the photosensitizing agent reaches adequate concentration in the cell. The photosensitizing agent precursor (e.g. ALA-PDT), apart from penetrating the cells should follow adequate biochemical tracts which can turn it into the proper photosensitizing agent. In order to increase the agent cellular penetration efficacy, the studies are carried on to place it in liposomes [18]. The third stage is based on the lesion irradiation which induces the agent toxic activity.

PDT involving ALA precursor (PDT-ALA) is vastly used in superficial changes treatment both on the skin and mucous membrane of the oral cavity. While the superficial changes irradiation, the patients usually complain of the slight pain, burning sensation, reddening and oedema at the site of the agent application. These symptoms, however, do not last longer than 24 hours after the procedure completion [19]. There are some reports claiming that the green light use completely eliminates the pain during the procedure [20]. Excellent final cosmetic effect should be taken into consideration as well. PDT can be an alternative way to treat the lesions the extensiveness of which hinders the use of classical surgical or cryogenic methods. At present times, PDT is not confined to superficial changes only as due to the latest endoscopic methods, the photosensitizing agent can reach almost all the internal organs.

The goal of the presented paper is the assessment of the photodynamic therapy in oral leukoplakia treatment.

Material and Methods

From April 2001 till November 2003, 20 patients aged 20–27 underwent photodynamic therapy. Histopathologically confirmed multifocal oral leukoplakia was found in all these patients and one
patient revealed papillomatous leukoplakia. This group comprised 12 patients after unsuccessful surgical or cryogenic procedures. In the treatment, 0.1% chlorophyll gel was topically administered directly on the pathologic lesion 4–5 hours before the irradiation. The radiation wavelength was 630 nm and it was generated by Secura PDT laser. The laser strength was 700 mW and the dose 100–200 J/cm². Every 21–30 days, 3–5 procedures were repeated depending on the treatment results and the patient’s reaction.

Results

In the group of 20 patients, the total response to the treatment was observed in 16 persons. One female patient with papillomatous leukoplakia required the surgical operation. Partial response to the treatment was observed in 3 patients (decrease of leukoplakia focuses number) and the surgical resection of the remaining lesions was used to arrive at the treatment completion. Other patients have been followed up without the disease recurrence. During the photodynamic therapy, the patients complained of the burning sensation and slight pain in the irradiation site which subsided along with the treatment.

Conclusions

The obtained therapeutic effects point at the high efficacy of the photodynamic therapy in the mucous membrane leukoplakia treatment. This especially refers to the cases of many localizations when other methods are inefficient. The advantage of this method is tissues healing by regeneration with slight scar formation, non-invasive character as well as the possibility of the procedure performance in the course of one day hospital stay which considerably reduces the costs. This form of therapy limitation, however, is the photosensitizing agent various resorption by tissues which hinders determination of necrosis depth in the irradiated lesions.

References


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