Photodynamic Therapy in Cancer Treatment

RCT summary for patients

Abstract

Photodynamic therapy (PDT) is a medical treatment that uses a drug, a photosensitive molecule called a photosensitizer, and a specific wavelength of light (generally infrared light) that activates the sensitizers. The procedure consists of administering (either locally or systemically) a photosensitizing drug, which is retained selectively by malignant tissue. The tissue to which the drug has been administered is then irradiated with light, which induces a series of photochemical reactions. These reactions occurring in the immediate locale of the light-absorbing photosensitizers mediate cellular toxicity in the tumor and induction of a local inflammatory reaction. PDT has been under study for several decades and is now an emerging treatment modality for a range of primarily malignant conditions. It is generally used as either a primary treatment or as an adjunctive treatment alongside surgery or chemotherapy. PDT is under clinical investigation for the treatment of cancers of mainly the head and neck, skin, esophagus, lung, gastrointestinal and genital tract, bladder, prostate, and brain. Recent systematic reviews revealed that PDT can be considered as an option in the treatment of malignant and premalignant non-melanoma skin lesions. It is also useful in the treatment of Barrett’s esophagus and unresectable bile duct cancer. The real advantages of PDT are the lower morbidity rates, improved functional and cosmetic outcome, and simplicity of the technique.

What is it?

PDT is a treatment modality involving the topical or systemic administration of a photosensitizer. The photosensitizers are taken up preferentially by the cancer tissue. A period of time is required to permit photosensitizer uptake, ranging from a few minutes up to several days. The photosensitizers are then activated at a specific wavelength of non-thermal monochromatic light and in the presence of oxygen induce a series of photochemical reactions leading to a destruction of cancer. PDT also damages the tumor-associated vasculature which may lead to local depletion of nutrients and oxygen. The destruction of tumor cells is manifested as swelling and formation of necrotic tissue. The tissue eventually sloughs away (or is resorbed), and there is normal healing of the treated site. The evident advantage of PDT over other conventional cancer treatments such as chemotherapy and radiotherapy is its minimal side effects, reduced long-term morbidity, no drug resistance and the fact that PDT does not compromise future treatment options for patients with residual or recurrent disease. It has the ability to preserve the anatomic and functional integrity of many organs such as the skin, tongue, bladder or larynx. Selected patients with inoperable tumors, who have exhausted other treatment options, can also achieve improvement in quality of life with PDT. Moreover, PDT can be applied alone or in combination as an adjuvant therapeutic modality with chemotherapy, surgery, radiotherapy and immunotherapy. Finally, many PDT procedures can be performed in an outpatient or ambulatory setting, thereby not only reducing costs, but also making the treatment patient-friendly. However, disadvantages of PDT do exist. The majority of currently approved
photosensitizing agents lack a complete selectivity and localization of the photosensitizer in tumors vs. normal tissue. Most wavelengths of light cannot penetrate through more than 1-2 cm of tissue using standard laser and LED technology, thus limiting application of PDT to the treatment of tumors on or under the skin, or on the lining of some internal organs or cavities.

**Does it work?**

PDT is approved for clinical use in a number of countries worldwide for the elimination of early stage malignancies, palliation of symptoms, and reduction of obstruction in patients with late stage tumors. Its acceptance into mainstream clinical practice is exemplified by approval for its use in several conditions by National Guidelines such as NCCN and NICE. These guidelines reported that there is adequate evidence of the efficacy of PDT for the treatment of actinic keratosis, Bowen’s disease and basal cell carcinoma to support its use for these conditions, while confirming the superiority of cosmetic outcome over standard therapies (e.g. cryotherapy, surgical excision). It is also reported that current evidence on the efficacy of PDT for patients with Barrett’s esophagus with high grade dysplasia (HGD) is adequate, provided that patients are followed-up in the long term. Several reports of the outcomes of PDT as an advanced palliative strategy for bile duct cancer have noted significant improvements in quality of life and survival after PDT and stenting. Evidence appears to be adequate to support the use of PDT for early-stage and advanced esophageal cancer. PDT is particularly well suited to the treatment of lesions of the head, neck, and oral cavity, which is used with either curative or palliative intent. This therapy is effective as well in the curative treatment of early stage lung cancer, in tumor debulking and palliation of symptoms in tracheobronchial obstruction from non-small cell lung cancer. For most treatments, however, it is premature to state whether PDT is superior, equivalent, or inferior to other ablative treatments.

**Is it safe?**

In essence, PDT is a process which involves ablating a lesion and creating a wound that has to heal. For small superficial therapies this process may occur in a fairly mild form with minimal pain, wound healing or other cosmetic and functional issues. However, for larger tumor volumes or located deeper within the body specific complications may occur. Pain is currently the main limiting factor for cutaneous PDT. Maximal pain usually occurs in the early part of irradiation during therapy and then gradually reduces. The photosensitizers are said to be essentially inert, therefore, application should be well tolerated unless the patient is allergic to the drug. However, once applied with photosensitizers the patient is photosensitive almost immediately so photosensitivity precautions are critical to prevent improper and unwanted PDT. For topically applied photosensitizers this means a local bandage to prevent local light exposure. For systemic photosensitizers this translates to avoiding direct sunlight for various lengths of time depending on the photosensitizer employed.
More info

Professional Societies/Organizations

European Society for Photodynamic Therapy in Dermatology (www.euro-pdt.com)
European Platform for Photodynamic Medicine (http://www.eppm-photomedicine.org)
International Photodynamic Association (http://sites.pcmd.ac.uk/ipa)