Photodynamic Therapy for Gastrointestinal Cancer, How Can We Use It in Real Practice

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Introduction

Photodynamic therapy (PDT) is a therapeutic modality involving the administration of a photosensitizer that is avidly retained by neoplastic cells, followed by local illumination with light of specific wavelength in the presence of oxygen molecules. PDT can ablate rapidly proliferating tissues including dysplastic and malignant lesions by providing localized cell death. The major drawbacks to this therapy are its capital costs, per procedure expenses, and prolonged potentially severe cutaneous and ocular phototoxicity.

PDT is still widely used for palliative and salvage treatments of various gastrointestinal malignancies by virtue of its minimal invasiveness, high selectivity for cancer, and simple procedure with better patient compliance. Although the frequency of PDT is decreasingly, I would like to find how can it to be useful in real practice..

PDT process

Firstly, there should be oxygen in the cells or tissues. Then, photosensitizers accumulate in the target area. When the light is irradiated, the photosensitizer is activated, then, the singlet oxygen is produced, which induces cytotoxicity. In the clinic, a photosensitizer is administrated into the bloodstream. The photosensitizer is absorbed by cells all over the body, but outstays in cancer cells. When the target tissue is exposed to light, an active form of oxygen is produced and destroys the cancer cells.

Indications of PDT

Photodynamic therapy is now used for the treatment of obstructive esophageal cancer, obstructive endobronchial lung cancer, actinic keratosis, and Barrett’s esophagus. Several clinical trials are under way for treatment of non-small cell lung cancers, mesothelioma, intraperitoneal malignant tumors, head and neck cancers, brain tumors, skin cancers, and prostate cancers.
Current applications in gastrointestinal diseases

I will show you the current application of photodynamic therapy in the GI field. PDT can be used in the palliation of unresectable esophageal cancers without response to chemotherapy or radiation therapy.1,2 Prior studies showed that dysphagia was improved after PDT in obstructive esophageal cancer patients. The luminal diameter was increased, and the patient survival was significantly higher in the combination treatment group including PDT than the single treatment groups.2 PDT has been used also in treating early stage esophageal cancers. The representative study showed that the combination treatment group including PDT had excellent survival than the PDT alone group.3 In western countries, Barrett esophagus is common problem. For treatment of Barrett’s esophagus, PDT has been used and its efficiency was good, For example, conversion to normal mucosa was shown in more than 75% of patients and complete resolution was achieved in 43%.4 Except esophageal diseases, PDT has not been used frequently in the gastric and colorectal diseases.

Causes for limited use of PDT in GI diseases

Excellent new procedures have been emerged, such as mucosectomy for treatment of early GI neoplasia, and stent insertion for decompression or palliation of bowel obstruction.5,6 PDT is not a simple method because the photosensitizer should be injected prior to the therapy and patient should be kept away from light after then. Photosensitizer is not accumulated selectively in the target area and it just outstay in the cancer tissues.

How we use PDT in real practice with current technology.

With the current technology, PDT can be used to treat the patients with local failure after chemoradiotherapy. Professor Muto will talk about this in the next session. PDT was used to treat the esophageal cancer, which was in-grown after placement of expandable stents, of which authors reports said that dysphagia was relieved after PDT in some patients.7,8

How we can use PDT in real practice with technology development.

Besides of development of photosensitizers and lasers, PDT can be used with conjugation with specific targeting molecules, combination treatment with other modalities. PDT can also be applied in new areas. Superior therapeutic effects were induce long-term tumor growth control.9 Use of specific targeting carriers can enhance the tissue specificity and therapeutic efficacy.10 Furthermore we can use advanced delivery systems like liposomes, ligand-based targeting with insulin, epidermal growth factor, adenoviral proteins, water-soluble polymer carriers, and pH-responsive polymeric micelles.11-13 Protection of normal tissue with drugs from possible PDT side effects if the photosensitizer is used in a high dose.14

Conclusions

PDT offers a minimally invasive treatment option for selected patients with GI cancer, particularly those with early-stage disease who are not candidates for surgery, those with locally advanced obstructive lesions, and
those for whom other treatments have failed to provide a benefit. With development of technologies, PDT can be used widely in the GI field.

References