CANCER FACTS

National Cancer Institute • National Institutes of Health
Department of Health and Human Services

Photodynamic Therapy for Cancer: Questions and Answers

Key Points

- Photodynamic therapy (PDT) combines a drug (called a photosensitizer or photosensitizing agent) with a specific type of light to kill cancer cells (see Questions 1 and 2).
- The U.S. Food and Drug Administration (FDA) has approved the photosensitizing agent called porfimer sodium, or Photofrin®, for use in PDT to treat or relieve the symptoms of certain cancers (see Question 3).
- Patients treated with porfimer sodium should avoid direct sunlight and bright indoor light for at least 6 weeks after treatment (see Question 5).
- Researchers continue to study ways to improve the effectiveness of PDT and expand its use to other cancers (see Question 6).

1. What is photodynamic therapy?

Photodynamic therapy (PDT) is a treatment that uses a drug, called a photosensitizer or photosensitizing agent, and a particular type of light. When photosensitizers are exposed to a specific wavelength of light, they produce a form of oxygen that kills nearby cells (1, 2, 3).

Each photosensitizer is activated by light of a specific wavelength (3, 4). This wavelength determines how far the light can travel into the body (3, 5). Thus, doctors use specific photosensitizers and wavelengths of light to treat different areas of the body with PDT.

2. How is PDT used to treat cancer?

In the first step of PDT for cancer treatment, a photosensitizing agent is injected into the bloodstream. The agent is absorbed by cells all over the body, but stays in cancer cells

longer than it does in normal cells. Approximately 24 to 72 hours after injection (1), when most of the agent has left normal cells but remains in cancer cells, the tumor is exposed to light. The photosensitizer in the tumor absorbs the light and produces an active form of oxygen that destroys nearby cancer cells (1, 2, 3).

In addition to directly killing cancer cells, PDT appears to shrink or destroy tumors in two other ways (1, 2, 3, 4). The photosensitizer can damage blood vessels in the tumor, thereby preventing the cancer from receiving necessary nutrients. In addition, PDT may activate the immune system to attack the tumor cells.

The light used for PDT can come from a laser or other sources of light (2, 5). Laser light can be directed through fiber optic cables (thin fibers that transmit light) to deliver light to areas inside the body (2). For example, a fiber optic cable can be inserted through an endoscope (a thin, lighted tube used to look at tissues inside the body) into the lungs or esophagus to treat cancer in these organs. Other light sources include light-emitting diodes (LEDs), which may be used for surface tumors, such as skin cancer (5).

PDT is usually performed as an outpatient procedure (6). PDT may also be repeated and may be used with other therapies, such as surgery, radiation, or chemotherapy (2).

3. What types of cancer are currently treated with PDT?

To date, the U.S. Food and Drug Administration (FDA) has approved the photosensitizing agent called porfimer sodium, or Photofrin®, for use in PDT to treat or relieve the symptoms of esophageal cancer and non-small cell lung cancer (7). Porfimer sodium is approved to relieve symptoms of esophageal cancer when the cancer obstructs the esophagus or when the cancer cannot be satisfactorily treated with laser therapy alone. Porfimer sodium is used to treat non-small cell lung cancer in patients for whom the usual treatments are not appropriate, and to relieve symptoms in patients with non-small cell lung cancer that obstructs the airways. In 2003, the FDA approved porfimer sodium for the treatment of precancerous lesions in patients with Barrett's esophagus (a condition that can lead to esophageal cancer) (8).

4. What are the limitations of PDT?

The light needed to activate most photosensitizers cannot pass through more than about one-third of an inch of tissue (1 centimeter). For this reason, PDT is usually used to treat tumors on or just under the skin or on the lining of internal organs or cavities (3). PDT is also less effective in treating large tumors, because the light cannot pass far into these tumors (2, 3, 6). PDT is a local treatment and generally cannot be used to treat cancer that has spread (metastasized) (6).

5. Does PDT have any complications or side effects?

Porfimer sodium makes the skin and eyes sensitive to light for approximately 6 weeks after treatment (1, 3, 6). Thus, patients are advised to avoid direct sunlight and bright indoor light for at least 6 weeks.

Photosensitizers tend to build up in tumors and the activating light is focused on the tumor. As a result, damage to healthy tissue is minimal. However, PDT can cause burns, swelling, pain, and scarring in nearby healthy tissue (3). Other side effects of PDT are related to the area that is treated. They can include coughing, trouble swallowing, stomach pain, painful breathing, or shortness of breath; these side effects are usually temporary.

6. What does the future hold for PDT?

Researchers continue to study ways to improve the effectiveness of PDT and expand it to other cancers. Clinical trials (research studies) are under way to evaluate the use of PDT for cancers of the brain, skin, prostate, cervix, and peritoneal cavity (the space in the abdomen that contains the intestines, stomach, and liver). Other research is focused on the development of photosensitizers that are more powerful (1), more specifically target cancer cells (1, 3, 5), and are activated by light that can penetrate tissue and treat deep or large tumors (2). Researchers are also investigating ways to improve equipment (1) and the delivery of the activating light (5).

Selected References

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6. Capella MAM, Capella LS. A light in multidrug resistance: Photodynamic treatment of multidrug-resistant tumors. *Journal of Biomedical Science* 2003;10:361–366.

7. U.S. Food and Drug Administration (December 2003). A*pproved claims for palliative line therapy*. Retrieved December 29, 2003, from: http://www.accessdata.fda.gov/scripts/cder/onctools/linelist.cfm?line=Palliative.

8. U.S. Food and Drug Administration (August 2003). *FDA approves photofrin for treatment of pre-cancerous lesions in Barrett's esophagus*. Retrieved December 29, 2003, from: http://www.fda.gov/bbs/topics/ANSWERS/2003/ANS01246.html.

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Related Resources

Publications (available at http://cancer.gov/publications)

- Cancer Facts 2.11, *Clinical Trials: Questions and Answers*
- Cancer Facts 6.7, *Cancer: Questions and Answers*
- Cancer Facts 6.20, *Metastatic Cancer: Questions and Answers*

National Cancer Institute (NCI) Resources

Cancer Information Service (toll-free)

Telephone: 1–800–4–CANCER (1–800–422–6237)
TTY: 1–800–332–8615

Online

NCI's Web site: http://cancer.gov
LiveHelp, NCI's live online assistance:
https://cissecure.nci.nih.gov/livehelp/welcome.asp

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