Photodynamic Therapy

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Overview

- Basically, photodynamic therapy (PDT) is the use of light activated compounds, known as photosensitizers, to kill target cells.

Image from: 
www.photochembgsu.com/applications/therapy.html
Why is it important?

- It provides an alternative treatment for cancer
- It is efficient for treating skin conditions, such as acne
- It could overcome drug-resistant bacteria and treat fungal, viral and parasitic infections
Where do optics come in?

- In the activation of the photosensitizer
- In light’s interaction with the tissues of the body

Image from: www.answers.com/topic/photodynamic-therapy
Activation of Photosensitizer

- S: molecule of photosensitizer
- hv: energy of applied light
- 1S: molecule in singlet state
- ISC: intersystem crossing
- T: molecule in triplet state
Activation of Photosensitizer

Ground State  Singlet State  Triplet State
Activation of Photosensitizer

- Type I
  \[ T \rightarrow S^- + A^+ \]

- Type II
  \[ T + ^3O_2 \rightarrow S + ^1O_2 \]

- The ion \((A^+)\) and the singlet oxygen \((^1O_2)\) cause cell death
Light’s Interaction with Tissue

- Light interacts with tissue in four different ways
  - Reflection
  - Refraction
  - Scattering
  - Absorption
Light’s Interaction with Tissue

- Intensity at a given depth (x)
  \[ I_x = I_0 e^{-(a_{abs} + a_{sca})x} \]
  - \( I_0 \): intensity at tissue surface
  - \( a_{abs} / a_{sca} \): absorption and scattering coefficients
  - \( I_x \): intensity at given depth

- Effective penetration depth is where \( I_x \) is 37% of \( I_0 \)
Light’s Interaction with Tissue

![Graph showing absorbance vs. wavelength for different substances, with an indication of the optical window for PDT.]

- H₂O
- Hb(H₂O)
- Hb(O₂)
- Melanin
Applications: Cancer Treatment

Cancer cells 24 hours after treatment

Cancer cells 72 hours after treatment

Images from: www.xytos.com/biotech_how.htm
Applications: Acne Treatment

Male: Before and after one month of three sessions

Female: Before and after one month of three sessions

Images from: www.modernmedicine.com/.../Article/detail/562921
Thank you!