

Abstract

This paper investigates the pharmacokinetics of the optical contrast agent indocyanine green (ICG) as a malignancy indicator for breast cancer. Several authors have conducted optical measurements using indocyanine green (ICG) in animal models (Coclin, Cuccia, Gurufi).

The leakage and the drainage out of the EES is given by:

\[ \frac{dC(t)}{dt} = k_p C(t) - k_m C(t) \]

The leakage and the drainage out of the plasma is given by:

\[ \frac{dC(t)}{dt} = -k_m C(t) + k_p C(t) \]

Actual bulk ICG concentration:

\[ m(t) = v_p C(t) + v_m C(t) \]

State of the Art

Gurufi presented a two-compartment model for ICG kinetics for an animal subject and estimated model parameters.

Challenges and Significance

Due to highly non-linear nature of the pharmacokinetic parameter estimation, variation in parameter values from one subject to another, and sparse data available in clinical and laboratory settings a systematic and robust approach is needed to model and analyze ICG pharmacokinetics.

Technical Approach

In normal tissue:

- Blood flow indicator in tight capillaries of normal vessel.
- May act as a diffusible extravascular flow in leaky capillary of cancer vessels.

In tumor:

- Low total Hb
- Low tissue oxy-hemoglobin
- Low tissue deoxy-hemoglobin
- Low C0 DTPA enhancement levels

Fisher Rat Data Analysis

Data acquired from four Fischer rats adenocarcinoma tumor cells with two different tumor stages.

Rats 1, 2: Necrotic
- Low tissue oxy-hemoglobin
- Low total Hb
- Low C0 DTPA enhancement levels

Rats 3, 4: Edematous
- High water content

Tumor information

Three different patients with different tumor types are included in this study.

Case 1: Fibroadenoma
- Tumor: 12 cm in diameter, located around 6-7 o'clock, breast size 9 cm diameter.

Case 2: Adenocarcinoma
- Tumor: 23 cm in diameter, located around 4-6 o'clock, breast size 7.7 cm diameter.

Case 3: Invasive ductal carcinoma
- Tumor: 3.4 cm in diameter and located around 6 o'clock.

References

[1] Burak Alacam, Birsen Yazici, Xavier Intes, Britton Chance
(1) Rensselaer Polytechnic Institute, (2) University of Pennsylvania