Abstract

Single fraction Targeted Arcadiotherapy (Targit) is a new concept of percutaneous breast irradiation that is being tested in randomized trials. Targit scores econoic accuracy, would delay and all therapeutic advantages. We present a mathematical model of growth for single fraction in a healthy breast tissue and in tumor tissues. We have derived this model to compare the success probabilities for both tumor tissues and normal tissues, and we have derived the effects of external beam radiotherapy and Targit. Leveling up can arise from step changes in tumor tissues or from morphological changes in the tumor bed that harbor profound genetic changes, such as loss of heterozygosity or tumor suppressor genes (LOH). Our mathematical analysis indicates that Targit would eradicate all tumor cells and reduce the risk of local recurrence. However, the effect of external beam radiotherapy and Targit need to be investigated more thoroughly. Our work is an initial attempt to model a biologically complex phenotype that has not been investigated before. We extend our model to simulate cellular and cellular models with molecular responses to multi- hit tumour tissues and the factors affecting the outcome of therapies that are ongoing at one center.

Mathematical Model

Three different cases: solid tumour invading the host breast tissue and radiation therapy (RT) development or (a) local recurrence.

Plots

Simulation of solid tumour and local invasion. The experimental results confirm that tumor cells and radiation therapy (RT) development or (a) local recurrence.

Mutations in adjacent tissue

- Loss of heterozygosity (LOH) in tumor suppressor genes (TS) has been identified as a strong indicator for local recurrence.
- Targit is an advanced and developed in the future.
- Attention accumulated before failure can be applied throughout the treatment of the disease, allowing early detection and, therefore, improving the outcome.
- A novel strategy: LOH ensures tumor suppressor genes of all 'daughter' cells present even for multiple mutations.

Nature of the collaboration

The aim of our study is to evaluate the potential of Targit to prevent local recurrence. We have initiated the Targit trial and an active member of the steering committee. AJ Munro is a local recurrence and mathematical modeling. He initiated the Targit trial and is an active member of the steering committee.

Background

External beam radiotherapy

Patients undergoing breast conserving surgery routinely receive external beam radiotherapy (EBRT). This adjuvant radiotherapy is intended to eradicate cancer cells that have not been excised by surgery and prevent local recurrence. The addition of EBRT to surgery often results in significant late effects in the normal breast tissues.

Targit-the technique-'Intra-beam'

A single fraction Targeted Arcadiotherapy (Targit) accelerates that delivers 20 Gy in 5 fractions or 15 Gy in 3 fractions into the breast tissue, while maintaining the same level of local recurrence.

Hypothesis

1. The Targit trial is based on the finding that 5% of isolated microcalcifications on mammograms are malignant, and that the probability of local recurrence is high in patients undergoing surgery (for biopsy) – either removing the breast or conserving it. We assume that the tumor bed of each patient will have the same microenvironment as the original tumor was located in the breast. This possibility of having metastasized is small, and it is not the local recurrence probability we are interested in. However, we compare the probability of Targit successful outcomes with the 'normal' recurrence of local recurrences.
2. We assume that the Targit technique is able to deliver 20 Gy per fraction.
3. We have assumed that the Targit technique is able to deliver 20 Gy per fraction.

Why a model?

Although there are some mathematical models for functional radiation therapy, there is no reliable model to simulate different scenarios at single fraction radiotherapy. Therefore, designing of new treatment strategies and protocols for single fraction radiotherapy would be beneficial in designing better clinical trials. They could also be used in conjunction with a new class of biological knowledge as presented in this paper.

Mathematical Modelling of Radiotherapy Strategies for Early Breast Cancer

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1. Background

2. Modelling Radiotherapy

3. Results

4. Conclusion

5. References

1. Conclusion from our initial model

Our simulations have shown that on a macroscopic level flutaneous dose (ED) in single fraction EBRT is eradicating stoya cancer cells in the tumour bed.

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