Chapter 11.6 - Case Study: Tumor Growth

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author:

date:

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First Growth Phase

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<img src="./tumourhypoxia2.png" height=533px width=800px />

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What do we expect?

- Oxygen concentration decreases as we are closer to the center (lower $r$) $\rightarrow$ diffusion equation 9.39:

$$

D \frac{1}{r^2} \frac{d}{dr} \left( r^2 \frac{dC}{dr} \right) + M(r) = 0,

$$

where $M(r) < 0$ because cells are \*consuming\* oxygen.

First Growth Phase (Cont.)

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If we have a constant oxygen consumption rate, $M(r) = -A\_0$ (is this a valid assumption?), and boundary conditions $0 < r < R(t)$, we can solve for $C$:

$$

C(r) = c\_1 - \frac{A\_0}{6D} \left( R^2 - r^2 \right),

$$

where $c\_1$ is the initial concentration of oxygen on the surface ($r=R(t)$).

This solution is only valid while $C(r) > c\_q$, since $c\_q$ is the concentration of oxygen at which the tumor cells become quiescent.

First Growth Phase (Cont.)

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What is the radius at which the tumor cells start to become quiescent, $r\_q$?

- With $C(0) = c\_q$ at $r = 0$ and $R = r\_q$,

$$

r\_q = \sqrt{ \left( c\_1 - c\_q \right) \frac{6D}{A\_0} }, \text{ where } c\_1 > c\_q,

$$

## Observations

- The radius $r\_q$ decreases with the difference $c\_1 - c\_q$,

- $r\_q$ increases as the absorption rate $A\_0$ decreases (?).

Now, let's expand this model to include the radius of the tumor at time $t$.